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HUMAN ENGINEERING[1]

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Recently there has come upon our contemporary scene a binomial expression which is supposed to be concerned with making concepts fit the reactions of people, that is "Human Engineering." In the past the prevalent philosophy was to force the human personality into preset concepts. This supposedly new philosophy is used throughout the industrial world in the form of color shades for appeal, reflectorized paint, design to attract, and endless other methods to further consumer sales. I wish to apply this human engineering concept in a different role, that is, the molding of semimature human beings into full adult personalities with directed purpose of thought and energy. Human engineering then, as used here, may be thought of as the final process in this "cerebral polishing" to obtain this total personality. The educator's role in this all important engineering should and must be paramount.

It might be of value to digress for a moment and consider the engineering which often has occured in the evolution of an educator. As all of us know, the scientific method postulates at least three major aspects, namely, observation or data collecting, experimentation, and interpretation. A former President of this organization paraphrases these three as follows: pedal, manual, and cerebral. Many of us have, knowingly or unknowingly, carried out this basic concept in our own engineering processes; that is to say, prior to any formal scientific training, we did the pedal part or data collecting as boys in the woods and fields. We spent most of our energetic years with manual scientific work and experimentation and finally we sat back to cerebrate and interpret much as the ancient Greek philosophers. Perhaps, rather, it's just the aging process which puts us into this category, in which the environmental resistance exceeds the biotic potential, and we slip into the philosopher, or educator, or both classes. Your attention is directed to the fact that the word is *educator*, not *educationist*.

Just how or when or why we metamorphose into an educator is not our present concern although it is an interesting topic and should be investigated experimentally. One wonders if perchance the individual, through some chromosomal aberration, has become preadapted such that in a suitable environment he finds a niche he can take over. Judging by the number of individuals in this educator group the niche should be quite full. Could it be that somehow some of these individuals have postadaptations which allow them to rise higher than the others and give the entire group a *raison d' etre*?

Human engineering has become more and more complicated due to our ever increasing knowledge and to the demand for the production of civilian and military

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experts. This ever growing mass of knowledge, as well as the rapidly changing social and economic concepts, apparently result from man's enlarged and much convoluted cerebrum. In spite of or because of this large cerebrum our children need more and more education to maintain the standards of our country. This is in extreme discord or perhaps complete accord when compared to animals lower in the evolutionary scale than man. Here the behavior pattern is more or less rigidly fixed, and it is not necessary for these animals to learn much or any of it. For example, in the potter wasp, *Eumenes fraternus*, the adult female emerges from a juglike cell fashioned from mud by its mother, which it has not and never will see, and soon fashions a similar juglike cell of its own, without any previous training in the art of ceramics. Through a small opening in the top of this, she will place lepidopterous and coleopterous larvae, previously paralyzed by stinging them in the exact location which will not kill but only paralyze. On one of these larvae, she will lay an egg before inserting it in the jug, which, after filling, she will seal and then proceed to repeat the process again.

In the vertebrates, the bird, one of the most highly developed automatons, needs no instruction nor even observation to fabricate a nest. There is no need of tools in the sense we think of tools. Have you watched a robin build a nest? After the foundation is laid down, the mud cup must be made and covered with dried grass and then lined. With complete how-to-do-it-youself instructions we would have great difficulty reproducing a robin's nest even with our tools and our cortical ability.

If one should wish to give a name to the activities just mentioned, would they be called instincts, tropisms, reflexes, or intelligence? It is generally agreed that neither insects nor birds have a neopallium. In the insects the greater part of their behavior is determined by their genes and transmitted by heredity. In the birds a relative increase in the size of the corpus striatum would seem to substitute for the lack of a neopallium and a smooth cerebrum. In fact, some workers believe that the corpus striatum of birds is homologous to the neopallium of higher animals. Man possesses a highly developed neopallium and can by the use of it change, modify, or even displace various aspects of his behavior, even to that of his social heritage. If then, this activity were called intelligence and compared to that called intelligence in man, would it not have to be classified into various orders or levels?

Man claims he is the *ne plus ultra* of living things; yet he must be taught to do practically all the activities which society requires for conformity or he must get them by experience, very often by the trial and error method. We all know that the School of Experience is a most effective educational instrument, but it has been said that the tuition to this school is frightfully high and the time needed for the course too great. It seems that the alternative then is to teach the human individual. To do this someone must be the "Mark Hopkins on the log" to this neophyte educatee. In other words, someone must be the educator. This then is the educator's "reason to be."

It can be said that we have been doing this in America since our forefathers stepped on Plymouth Rock—and doing it well. In fact, perhaps no other nation on this earth has our elaborate public education system. Yet in our progress in all fields of education, and with our vast educational resources, and our huge college and university enrollments, have we not moved with such speed that many basic concepts have been buried in so called Modernism? It would appear that one of our greatest educational problems is directiveness; that is, are we progressing or have we progressed beyond the basic principles of mathematics, science, literature, music, history, etc.? In the past these disciplines were taught in such a manner as to bring out the cultural background as well as the practical. Is it possible we are living too fast? Have we allowed our gadgetry to get too far ahead of our cultural education? Possibly we should return to the more

fundamental and basic education of a generation ago. If education must be adapted to today's needs, it may be well to use some of the principles of years ago. Those principles inculcated a cultural background, which is of as much or more value than the present day evaluation based on dollars and cents. Most of us here tonight are engaged in this field of education. Do you think we would have the same ideas or even similar ideas as to how the job should be done? I'm sure the diversity of thought in this respect would be as great as the problem involved. Perhaps we should give some thought to what we are doing and what we should do. The results of what we have been doing in recent years suggest repeating a few statistics. Comparing the number of college degrees conferred in 1948 with 1956 shows Bachelor's degrees up 20 percent, Master's degrees up 35 percent, and Doctorates up 97 percent.

Those of us connected with the various colleges are aware of the anticipated increase in enrollment facing us in the early 1960's. How they can be handled properly and adequately and financially by the colleges is not in the scope of this paper. That they are not all of college calibre is well recognized.

Even at the present time too much emphasis is placed on the education of the poorly endowed. That these must be trained to live as good citizens is well recognized, but we must face reality and understand that they cannot be trained into future leaders. Should not the well-endowed then receive more of our attention so that we may have well educated and broadly trained leaders? A trite phrase of today is that in order to be privileged one must be one of the underprivileged.

One of my former students in an article in the "Ohio Schools" states that it is time for us to stop working with teenage "drones" who do not want to learn themselves and prevent others from learning. He estimates that ten percent of the older high school pupils care littlé about getting an education and have thus lowered the standards in the average high school by twenty-five percent or more. Furthermore, he believes that two or three percent of that ten percent account for most of the discipline problems. He believes that our present school laws demand mediocrity and that is just what we are getting.

If then we can get those who genuinely desire a college education and have the native ability to acquire it, we should use our abilities to develop leaders in all fields of endeavor. Human engineering, I believe, is the only way to adequately control and direct the young college student. The student of today, with college qualifications, has the ability, energy, and eagerness, although the directive force and mature guidance are frequently missing. Often college educators feel this type of pampering or spoon feeding should be done in the home. This is quite true if the home is comprised of well informed, mature thinking parents who appreciate the problems of higher education and the impact of these factors on the young college student. Most of us will agree that most homes do not contain a well informed educator who understands both sides of the educational fence. In many cases parental guidance is lacking, inadequate, or even misguided. Nevertheless as educators we can't overlook these factors. The college student needs directiveness which must come more accurately from the experienced educator. Are we doing enough? Or could we do more? If we could do more in this respect, we should concentrate on certain aspects of this problem. I wish to discuss several very important, but frequently overlooked, and neglected phases briefly.

When I mention some of these phases you'll at once say that these should have been covered by the parents prior to school age and by the grade and secondary instructors before these young people come to college. Perhaps so, but as stated previously, we have no way to control this early training and I do not believe we should simply shrug our shoulders and say it's too late and it's too bad and thus wash our hands of the problem.

The first of these phases is reaction to self. Each human individual is a composite of the chance combination of the available genes throughout his ancestry and the impact of his environment since birth on this gene complex. Hence, excepting identical twins, and perhaps not even there, no two persons are exactly alike. The arthropod, or the bird, has a built-in behavior system which is standard equipment on all models of that species. This system is, as mentioned previously, a rigid one, for the most part incapable of modification. By way of an example, some years ago your speaker experimented with a cicada-killer, *Sphecius speciosus*, at her nest. As is generally known, this insect digs an underground nest and provisions it with cicadas, in much the manner of the potter wasp. When bringing her prey to the nest, she places it an inch or so from the nest opening and she then enters the nest; upon returning she picks up the cicada and drags it into the nest. When the cicada was moved to a different location during her inspection tour, the wasp moved about in circles until she located the cicada, whereupon she placed it at a different location and then she entered the nest. This same pattern of behavior was repeated each time the cicada was moved. To test whether this was the peculiar behavior of this individual cicada-killer, it was tried at other nesting sites and a similar pattern of behavior observed.

A human being may have a built in behavior system of inheritance, just as the wasp, but the system is capable of infinite and varied reactions resulting from the environmental impingements on a highly complex nervous system. Thus, this reaction to self is developed slowly but surely from the moment of birth. The mother of any child, if she will but take the time, can see it unfold and develop, change progressively and regressively, be modified and molded by reactions with members of the family and with the child's associates. The process goes through grade school, high school, college, and the rest of life. If, through those years, the molding process has followed the common socially acceptable pattern, we say we have a person well adjusted to our present society. If the molding process has not followed this path, the product is amoral, immoral, or maladjusted.

We, as college instructors, have no opportunity to get into the game of training until the later innings. Many may say that it is too late for us to do anything and in many cases it is. But many a ball game has been won in the last few innings and often we can effect great changes in a person during his college days if we but try. Again the ever present need for human engineering—that is the carefully directed guidance and leadership of the educator. Granted many appear to be rather too far gone before we have a chance to add our environmental impact —this is unavoidable. Yet our responsibility remains. In the classroom of seventy-five to one hundred students it would appear that our only impact is the examination. This is unfortunate and most undesirable. To offer adequate assistance we should know the student, not as the "cute blonde in the front row" or by "seat 31 in the 10 o'clock section," but as individuals. The instructor must know the person by name, where he is from, his general family background, and his aims and hopes as well as some aspects of his personality. This means personal interest on the part of the instructor, involving frequent conferences, etc.

Many may say that this is all well and good, and can be done easily in a small college but not in the large universities. It is perhaps more difficult in the latter, but that does not mean that it shouldn't be attempted or can't be done. Could not the fact that it isn't done or will not be done mean that the large university is much too large at the undergraduate level? If this part of the training is essential to the proper educational process, and I believe it is, then perhaps we should reorganize our thinking in regard to the distribution of the huge student load anticipated in the 1960's. Since the number of graduate students is increasing greatly, as has been shown, perhaps the large multimillion dollar institutions have a greater challenge to prepare the advanced student in his chosen speciality rather than to increase their numbers at the undergraduate level. The smaller colleges,

where this more personal contact may be made, may be able to exercise a greater choice in selecting their students from among those which show a definite ability to benefit from a college experience.

This concept of human engineering within the framework of the college is not too far from the function of the liberal arts design to develop the cultural side of the student within a wholesome personality. Often the exponents of the so-called arts subjects have implied, if not stated, that there is no culture in science. It is true that some or all the sciences are technical, abstract, detailed, and involved. There is a culture and beauty in the intricate way in which all science fits into an integrated whole. In fact, it is just this perception of the integrated whole which makes the scientist a cultured individual.

The second phase is the sense of responsibility to others. Just as a person must be true to himself, so he must be true to others. If the reaction to self has been properly developed in an individual by means of personal guidance in our human engineering program, then the sense of responsibility to others becomes a corollary of our first phase. There has been growing in the last twenty years an attitude of "it is not mine, so what." This is reflected in the spoiling of parks, natural resources, and the typical American pastime of defacing and destroying. Concomitant with this is the total disregard of the rights and the property of others by many individuals today. It is granted that this attitude is the universal one in nature; however, man has potentialities which allow him to be trained to rise above these baser attitudes; this can be fostered in our human engineering program.

We then, as educators, must train, develop, and inculcate this responsibility to others in all the students with whom we come in contact. It is my belief that it can be done and must be done for an adequate education. Over a period of more than twenty-five years I have tried to instill and develop these ideas in the students who have worked with me even though I got into the game in the last few innings of their formal educative process. The basic concepts which I have tried to weave throughout this paper are those which have been used on hundreds of students during this twenty-five year period in my research problem of human engineering. Success in such a problem is difficult to measure; however, I am quite certain that much of the work has not been in vain.

To the above requirements should be added the obvious phase of our responsibility to train the college student for his or her particular vocation. Generally speaking, we are trying to do this adequately but should we not keep checking on ourselves in this regard or even try ways and means to do the job better? Now and then one hears from the non-scientist that we are not doing the job well. We should take a positive approach to this and start selling science and science teaching to the general public. Industry advertises and continually keeps before the public the results of their work. Let us not hide our light under a bushel. Can't we present new and better methods of training students for their vocations? Obviously one must know some science and its applications not only in order to live but also to live better in this atomic age. In my experience many persons who had not planned on a career in science can be won for science by developing such an interest in them by effective teaching. Effective teaching means that we, as teachers, must have a great interest in our subject, which must carry over to our students. In doing this we must talk to them at the level of their understanding and lead them to think at higher levels. We should not attempt to turn all students toward science but appeal to those who have an interest or who have a potential ability in science. This really needs to be started in the grades and developed until we get these students in college where we may have a closer contact with them. Many may say that the sciences are difficult subjects, but are they any more so than other subjects? It is true that a definite language is necessary for their expression, but should that be any more difficult than learn-

ing any language in order to express our thoughts? Many good students wish to go into scientific work but have failed to take the proper subjects, particularly mathematics, in high school. Those who are in secondary school work should re-evaluate the work at this level and aid in making mathematics as well as the various sciences required courses. Those of us in college work should aid the secondary schools in the planning and carrying out of desirable curricular changes in addition to our training of scientists. Closer liaison between high school and college and university educators would be most desirable to assist each other with ideas and methods in our common responsibilities. High school instructors could be encouraged to take subject matter courses in their field and these courses should be acceptable for graduate credit. These should not be education courses, however. Could seminars be established for the discussion of subject matter and the problems of secondary teachers? This should not be a one way street; however, should not the college instructors visit the high schools to better understand the needs of the high schools and how to better train the undergraduate prospective high school teacher? There might be some excellent results obtained by inter-collegiate visiting on the part of all college instructors in science. Guest lecturers on an exchange basis would go far in stimulating the human engineering project. The National Science Foundation is working extensively on these problems. The Ohio Academy of Science is doing excellent work in one phase of this responsibility. The Junior Division of the Academy is in the hands of very capable men who are doing yoeman service for the potential scientists of our state. All of us should aid them in every possible way. Likewise, Dr. Ronneberg's Committee on high school curricular changes has done some very fine work. Dr. Cunningham's Committee concerned with problems relating to the future of science teaching in Ohio's schools has reported to the Academy at this meeting.

Those of us who are chairmen of the science departments of our Ohio colleges should have time or take time to counsel all students coming into their departments so that they may be aided in the proper choice of courses leading to the vocations they have chosen. Their philosophy of life at this stage of the game and what they think they want out of life should aid us in directing them in the proper channels. Is it possible that too often we spend so much time in research, pure or applied, that we are not stimulating young scientists or we are not doing enough human engineering? Do we share our interest and enthusiasm in research with young persons so that they may be stimulated to undertake such work?

In the process of training these potential scientists for their vocations, we need to add a catalyst to the several phases mentioned in order to produce the all inclusive effect which we must have—it is the ability to live and work with others. It matters not how brilliant, how successful, how noted one is in the work; unless one has this priceless ingredient, the individual is not a completely rounded personality. The undergraduate college is the last chance we have to aid in molding this completely rounded personality which requires individual educator help rather than a multimillion dollar physical plant. All of us know individuals who live as the hermit "in the peace of their self content" rather than "in a house by the side of the road." Perhaps those of us who are college educators have more of an opportunity to do this latter than some of the others. Until the student comes to college he usually lives at home, where there is more or less parental supervision. Often it seems to be mostly less. At college he is on his own for the first time and if the effort is made on our part, much can be done to mold the young person in the proper direction. Some folks believe that college professors climb into their ivy covered ivory towers and dwell there in perfect immunity to the everyday world about them. If one wants a frank statement in this respect, let him ask the man in the street to give his idea of the typical college professor. It is, therefore, especially necessary that we prove by our example that we are *not* ivory tower dwellers but that we are an integral part

of the world about us. In most occupations, even many scientific occupations, people must work in teams or groups. While there is and should be competition among them, for that is the American way, they should be able to live happily with others.

In conclusion, it is my belief that the role of the undergraduate college and our role is to dedicate our institutions and ourselves to human engineering as well as to education, so as to mold an educated, total personality from the eager, energetic rock 'n roll youth of today. This work in human engineering can be most rewarding and can develop an inward feeling of warmth as one looks back over the many young people who are doing excellent work in the many fields of science and in whose preparation one has had perhaps some small part. It would be interesting to know the results of this sort of guidance of students by the individuals in this audience. Such self appraisal might be illuminating—and surprising. It is my hope that in some small way this has and will contribute to the safety and the perpetuation of our American way of life.

Handbook of Biological Data. *Wm. S. Spector*, Ed. W. B. Saunders Co., Philadelphia, Pa. First Edition. 1956. xxxvi+584 pp. $7.50.

The quarto sized Handbook of Biological Data is a compendium which was prepared with the sponsorship of the Division of Biology and Agriculture of The National Academy of Sciences and The National Research Council. Funds were supplied by the U. S. Departments of Army and Navy, and by the Atomic Energy Commission, and the tables represent the correlated contributions of more than 4000 scientists, and the counsel of an additional 13,000.

Contributors and reviewers of the subject matter are alphabetized, then numbered, and references are made by these numbers. The table of contents also uses these numbers in citing the principal contributors for each subject. The index is in two parts, a Contributor-Reviewer index, and a Subject index, and both are used in correlation with the table of contents. The scientific and common names for every organism and chemical used are indexed, with organisms down to genus level only.

The guiding principle for inclusion of material was stated to be its basic importance or wide general interest, and its adaptability for tabular presentation. The range and amount of material assembled in this volume is tremendous, and for the production of a second edition with improved balance, better coverage, and with errors corrected, users are invited to advise the compiler.

The range of subject matter may be shown by the following list of divisions in the table of contents (divisions which are not marked in the text):

I. Biochemical and biophysical characteristics;
II. Genetics, cytogenetics, and reproduction;
III. Development and morphology;
IV. Nutrition, digestion and metabolism;
V. Respiration and circulation;
VI. Other physiological activities and performances;
VII. Biologically active compounds;
VIII. Environment and survival;
IX. Symbiosis and parasitism;
X. Ecology and biogeography.

THOMAS H. LANGLOIS

Medical Sciences, Volume I. *J. C. Bugher, J. Coursaget,* and *J. F. Loutit,* Eds. McGraw-Hill Book Company, Inc , New York. 1956. xii+165 pp. $6.00.

Those who have eyed the great tomes of papers presented at the International Conference for the Peaceful Uses of Atomic Energy in Geneva in 1955 will appreciate this readable digest of the medical aspects. There are chapters on the use of radioactive isotopes in diagnosis, isotopes for external and internal therapy and the principles of radiation safety and dosimetry. Each chapter is a critical review by a well known authority. Such a book as this is indeed essential to keep one abreast of the expanding field of medical applications and is highly recommended.

FRANK BATLEY

THREE NEW SPECIES OF *APHRICUS* WITH A NOTE ON *CTENICERA*

(COLEOPTERA: ELATERIDAE)

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In studying Elateridae the three following new forms were observed.

Aphricus neomexicanus n. sp.

Male.—Narrow elongate; light brown throughout, ventral surface, legs and antennae lighter.

Head slightly depressed on front, supra-antennal margin of frons continuous above labrum, finely carinate; labrum connate with clypeus and in same plane; surface densely, finely punctate, densely pubescent; antennae extending beyond humeral angles of elytra when laid along side, ratio of lengths of segments 1 to 11, 2: 1: 1.5: 2: 2: 2: 2: 2: 1.9: 2.6.

Pronotum about as long as broad, widest in front of middle; anterior margin broadly rounded, median lobe broad; basal margin sinuate, median lobe emarginate; side margins broadly rounded in front, then converging to slightly divergent hind angles, carina extending along side from hind angle to beyond middle; disk convex; surface densely, minutely punctate, clothed with recumbent pubescence. Scutellum heart-shaped, depressed in middle.

Elytra near base wider than widest part of pronotum; sides subparallel near base, constricted about middle then broadly rounded posteriorly to suture; disk convex, striate, punctures of striae small, well separated, interspaces minutely punctate, densely clothed with short recumbent pubescence.

Beneath mesocoxae separated, meso- and metathoracic suture distinct between mesocoxae, which are enclosed by meso- and metasternum, prothoracic sternopleural sutures slightly arcuate. Abdomen beneath densely minutely punctate, recumbent pubescence dense. Legs slender; tarsal segments 1 to 4 decreasing in length, claws with a tooth near apex.

Length 5 mm.; width 1.4 mm.

♀—unknown.

Described from specimens collected at light in Filmore Canyon, Organ Mountains near Los Cruces, New Mexico, July 12, 1956 by H. and A. Howden.

♂ holotype and paratypes in collection of author. Paratypes in collection of H. F. Howden to whom I am indebted for the material. Also in collection of M. C. Lane and Canadian National Collection.

Aphricus knowltoni n. sp.

Male.—Narrow, elongate; light brown throughout; antennae and mouth parts darker, abdomen beneath a much darker brown.

Head convex, front depressed; supra-antennal margin of frons continuous above labrum, finely carinate; labrum connate with clypeus and in same plane; surface densely finely punctate, clothed with recumbent light pubescence; antennae extending three segments beyond hind angles of pronotum, ratio of lengths of segments 1 to 11, 1.8: .8: 1.6: 1.8: 1.8: 1.9: 2: 2.1: 2.1: 2: 2.8.

Pronotum much wider than head, slightly longer than wide, widest about middle, wider at base than at apex; anterior margin sinuately rounded, median lobe broadly rounded; basal margin strongly sinuate; sides broadly rounded, hind angles produced, divergent, carinate externally; disk convex; surface densely minutely punctate, clothed with short recumbent pubescence. Scutellum heart-shaped, densely pubescent.

Elytra near base wider than widest part of pronotum; sides subparallel in front, broadly rounded posteriorly to suture; disk convex, striate, punctures of striae coarse and closely placed, punctures of interspaces minute; surface densely clothed with short recumbent pubescence intermixed with longer more upright hairs.

Beneath mesocoxae separated, meso- and meta-thoracic suture distinct between mesocoxae, which are enclosed by meso- and metasternum, prothoracic sternopleural sutures straight, slightly converging posteriorly. Abdomen beneath densely minutely punctate, clothed with fine pubescence. Legs slender; tarsal segments from 1 to 4 inclusive decreasing in length; claws not serrate.

Length 4.8 mm.; width 1.6 mm.

♀—unknown.

Holotype ♂ and paratypes labeled Washington, Utah, June 27, 1937, D. J. and J. N. Knull, collectors; one labeled Utah and one Cameron, Arizona, Aug. 19, 1950, D. J. and J. N. Knull, all in collection of author. Also St. George, Utah, July, H. F. Wickham; St. George, June 15 and July 29, E. W. Davis on *Chilopsis linearis* D. C. and *Hymenoclea salsola* T. & G., and Moab, Aug. 10, 1906 in collection of M. C. Lane to whom I am indebted for loan of material.

Variations. Color of dorsal surface is darker in one specimen, also the head and antennae vary to dark brown.

It can be separated from our other forms by its color.

I take pleasure in naming this species for G. F. Knowlton who has added a lot to our knowledge of the insect fauna of Utah.

Aphricus texanus n. sp.

Male.—Narrow, elongate, dark brown; mouth parts lighter; body and legs densely pubescent.

Head convex; surface densely, finely punctate, glabrous on vertex, pubescence long; mandibles prominent; labrum connate with clypeus and in same plane; supra-antennal margin of frons continuous above labrum, finely carinate; antennae extending beyond middle of elytra when laid along side, ratio of lengths of segments 1 to 11, 2: 1: 2.2: 2.8: 2.8: 3.2: 3: 3.2: 3.2: 3.4: 3.2.

Pronotum longer than wide, widest in front of middle; sides rounded in front, converging posteriorly, hind angles divergent with short fine carina on side near base; disk convex; surface densely punctured, punctures coarser than on head; dense pubescence long. Scutellum heart-shaped.

Elytra at base wider than widest part of pronotum; sides subparallel, broadly rounded apically to acutely rounded apices; disk with rows of coarse punctures, separated by less than their own diameters, punctures larger than those of pronotum, interspaces minutely punctate, sutural margin raised near apex, fifth interspace of elytron carinate near apex, long pubescence dense.

Beneath with metasternum truncate anteriorly, mesocoxae separated, meso- and meta-thoracic suture distinct between mesocoxae, which are enclosed by meso- and metasternum; prothoracic sternopleural sutures arcuate, slightly converging posteriorly. Abdomen beneath finely punctate, pubescence long. Legs slender, tarsal claws not toothed.

Length 5.1 mm.; width 1.4 mm.

♀—unknown.

Holotype ♂ collected at light 15 miles northeast of Rio Grande City, Texas, June 2, 1954, by H. F. Howden, in collection of author. I am indebted to Dr. Howden for the specimen.

This species is closest to *A. californicus* Lec. The shorter form, convex, coarsely punctured pronotum will separate it.

The following key will serve to separate males of genus *Aphricus*.

1. Sides of prothorax marginate from base to beyond middle 2
   Sides of prothorax not marginate 3
2. Second and third segments of antenna united not equal to length of fourth; tarsal claw without tooth ..... *tenuis* Fall
   Second and third segments of antenna united longer than fourth; tarsal claw with tooth ..... *neomexicanus* n. sp.
3. Pronotum and elytra not the same color ..... *luteipennis* Fall
   Pronotum and elytra same color 4
4. Second and third antennal segments taken together longer than fifth 5
   Second and third antennal segments taken together shorter than fifth 6
5. Color light brown; fifth interspace of elytra not carinate near apex ..... *knowltoni* n. sp.
   Color dark brown; fifth interspace of elytra carinate near apex ..... *texanus* n. sp.
6. Fifth interspace of elytra carinate near apex ..... *californicus* Lec.
   Fifth interspace of elytra not carinate near apex ..... *lanei* Knull

Ctenicera acuta (Knull)

This species which was described as an *Aplastus* (1946) should be placed in *Ctenicera* as we know the genus today.

REFERENCES

Fall, H. C. 1907. New Coleoptera of New Mexico. Trans. Amer. Ent. Soc. 33: 145–272.
———. 1928. New Plastoceridae and a new Cebrio. Psyche 35: 139–146.
Knull, J. N. 1946. A new species of *Aplastus* from Idaho. Ohio Jour. Sci. 46: 142.
———. 1956. A new species of *Aphricus* from California. Ohio Jour. Sci. 56: 290.
LeConte, J. L. 1853. Revision of the Elateridae of the United States. Trans. Amer. Phil. Soc. 10: 405–508.

Career Opportunities In Biology. *Russell B. Stevens.* Row, Peterson and Company, Evanston, Illinois. 1956. 63 pp. 36¢ ea., quantity rates.

A welcome addition to the occupational literature, where publications on biology as a career have been few and often superficial, this new monograph is a must for vocational counselors everywhere. Prepared by the Division of Biology and Agriculture, National Academy of Sciences—National Research Council, it is not only comprehensive and authoritative but also attractively bound and illustrated.

The contents are organized to answer any question which might conceivably be asked by a serious-minded young person considering a life-science career. The first portion of the monograph answers the following questions: What is biology? What are the qualifications? What opportunities are there? What rewards can one expect? The second portion includes: Who are the biologists? What education is needed? What is the biologist's role? Where can more information be obtained? In the final section, itself worth more than the price of the monograph, are units on the divisions of biology, its professional societies and publications, and an annotated bibliography of more than 200 references, both general and specialized, dealing with all applications of the biological sciences.

In terms of this monograph's probable appeal to laymen, specifically the teen-agers for whom it was written, some minor criticisms might be made. More frequent use of bold-face sub-headings would have added to the readability of long passages of text. Shorter sentences and less technical vocabulary, in some instances, would have been desirable. A few references in the bibliography date back so far as to raise the question of obsolescence. Aside from these few faults, the monograph is a much-needed and valuable contribution to the science reference shelves of any school, college, or public library.

MARJORIE HAMMOND

Caves of Missouri. *J. Harlen Bretz.* State of Missouri, Division of Geological Survey and Water Resources. Rolla, Missouri. Second Series, volume 39, 1956. xxii+490 pp. $2.50.

Caves of Missouri is a comprehensive guide to caves in a state well-known for its underground solution activity. It fills an existing gap in the inventory of cave information in the United States and, because of this has been expectantly awaited by speleologists everywhere. Introductory chapters deal with the origin of Missouri caves, phreatic and vadose solution, topographic relations of caves, and the origin and types of speleothems, the secondary carbonate deposits in caves. Thirty-nine caves commercially open to the public, either at present or in the past, are described in detail. Nearly 400 undeveloped or wild caves are outlined to a lesser degree. The whole book is profusely illustrated with photographs, maps, and diagrams. An appendix lists synonymous cave names; a glossary defines technical speleological terms.

Unfortunately Dr. Bretz's book has several shortcomings. The maps, while they show the general features of the cavern passages, do not supplement the text as well as they would if standard cavern mapping symbols were used. Theories of cavern origin, especially those dealing with vertical solution, are not borne out by actual cave conditions. And, no recognition is given to recently published speleological data either in the discussion or bibliography.

In spite of these deficiencies, *Caves of Missouri* is a valuable reference for the speleological research worker and the casual cave enthusiast.

PHILIP M. SMITH

SOIL MYCOFLORA ASSOCIATED WITH CONTINUOUS CROPPING OF CORN, OATS, AND WHEAT[1]

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Root rots and seedling blights are among the most destructive and most ineffectively controlled of plant diseases. According to Garrett (1944), the oldest and most effective method of controlling root rots of field crops is crop rotation. In regard to seedling blights and root rots of corn and wheat, it has been reported that the incidence of these diseases was reduced when these crops were preceded in the rotation by a crop of oats (Broadfoot, 1934; Sanford, 1946; Tyner, 1948; Odland *et al.*, 1950; and Kommedahl and Brock, 1954). Efforts are now being made to discover the underlying causes of variations in disease severity which accompany variations in crop sequence.

Among the proposed explanations of the effect of crop sequence on the incidence of root rots, one which has received a great deal of attention from plant pathologists is the relation of soil microflora to these diseases (Sanford, 1946; Weindling, 1946; Clark, 1949; Weindling *et al.*, 1950; Lochhead, 1952; Waksman, 1952; Simmonds, 1953; and Kommedahl and Brock, 1954).

In 1952 a continuing series of investigations into this problem was initiated at The Ohio Agricultural Experiment Station. Kommedahl and Brock (1954) assayed soil from continuously cropped corn, oats and wheat for numbers of fungi and found that the fungus counts from the oat plot were consistently higher than those from the corn or wheat plots. In agreement with the workers previously cited they found that, in greenhouse tests, less seedling blight of corn and wheat occurred when those crops were planted in soil taken from the oat plot than when they were planted in soil taken from the corn or wheat plots.

The study reported here was made during the growing season of 1953. The same continuously cropped plots used by Kommedahl and Brock were assayed for both numbers and kinds of fungi. The principal objectives of this study were: 1) to determine whether the fungi isolated from the different plots would differ in kind, and 2) to determine whether the total numbers of fungi isolated from the different plots would again have the same relation to each other (oats highest) as in 1952.

METHODS

The soil samples assayed in this investigation were obtained from three plots located on the agronomy rotation range of The Ohio Agricultural Experiment Station, Wooster, Ohio. These three plots had been continuously cropped since 1915 to either corn, oats, or wheat. The soil was a silty loam. Each of these plots received equal amounts of 0–14–7 fertilizer each year. No nitrogen had been added to these plots since 1936, when they were manured. After the harvest of the wheat, volunteer black medick (*Medicago lupulina L.*) grew in this plot and may have supplied some nitrogen. After harvest of the oats, a nearly pure stand of ragweed covered the plot. Little plant growth other than corn was present on the corn plot. The soil samples collected from these plots were assayed for numbers and kinds of fungi by a standardized soil dilution-plate technique.

[1]Work completed while employed as Research Assistant at The Ohio Agricultural Experiment Station, submitted in partial fulfillment of the requirements for Master of Science Degree at The Ohio State University in 1953. O.A.E.S. Paper No. 25–57 and Paper No. 603, Department of Botany and Plant Pathology, The Ohio State University.

The plots were assayed for numbers and kinds of fungi on four dates; June 30, July 7, August 18, and September 11, 1953.

1. *Collection of samples.* The soil samples were collected in sterilized screw-cap vials at three different depths (surface, 2 in., and 4 in.) from each of the plots. A vertical face was cut in the soil; the vials were held at right angles to the face at the proper depths and were filled by screwing the vial into the soil. The surface sample included soil to a depth of approximately ¼ of an inch. One sample was collected at each depth.

2. *Dilution technique.* An accurately weighed aliquot of approximately 0.100 g. of each soil sample was added aseptically to 10 ml. of sterile distilled water contained in a 125 ml. Erlenmeyer flask. The flasks were placed on a platform shaker (60 oscillations per minute) for 15 minutes to break up the soil particles. They were then shaken manually for approximately 20 seconds and 1 ml. of the suspension was immediately withdrawn with a sterile pipette and transferred to 50 ml. of sterile distilled water contained in a 250 ml. Erlenmeyer flask. The dilution was 1:5000. The resulting suspension was shaken thoroughly and 1 ml. aliquots were transferred onto the surface of each of 5 agar plates for each individual soil sample. Warcup's (1950) medium (Czapeks-Dox plus 0.5 percent yeast extract), acidified with lactic acid to pH 4.0, was used for the assays.

3. *Determination of the numbers and kinds of fungi.* The fungus colonies were counted following a 3-day incubation at 26°C. The colonies were consecutively numbered on the bottom of each of the petri plates. The mean number of colonies per set of 5 plates was then used to calculate the number of fungi per gram of oven-dry soil. Portions of all soil samples were dried for 24 hours at 110°C and the dry weight equivalent of the soil used in the dilution was computed. This dry weight equivalent was then used to calculate the number of fungi per gram of oven-dry soil.

Seven to 10 days after preparing the plates, the fungi reached a stage of growth at which they could be identified. All colonies not having a corresponding number on the bottom of the plates were assumed to be secondary. Some slow-growing fungi may have been excluded because of this assumption. The presence of secondary colonies obviously derived from sporulating original colonies made counts beyond the 3-day incubation period highly unreliable.

The fungus colonies were identified on the original dilution plates. When "spreaders," *Trichoderma spp.* or *Rhizopus spp.*, were present, it was still possible to identify most of the other fungus colonies in the plate, provided the identification was undertaken early.

The fungi were identified to genus except in the case of Aspergilli and Penicillia, which were identified to the groups as outlined by Thom and Raper (1945) in their "Manual of the Aspergilli" or to the series as outlined by Raper and Thom (1949) in their "Manual of the Penicillia." In the remainder of this paper the groups of the Aspergilli and the series of the Penicillia shall be referred to by the name of the specific fungus which characterizes the group or series. Two other extremely useful keys were "A Manual of Soil Fungi" by Gilman (1945) and "The Genera of Fungi" by Clements and Shear (1931).

EXPERIMENTAL RESULTS

1. *Distribution and frequency of the kinds of fungi isolated.* From the three plots, corn, oats, and wheat, four kinds of fungi predominated in the isolations. These were *Aspergillus fumigatus*, *Penicillium funiculosum*, *Trichoderma spp.*, and *Fusarium spp.* A collective total of 1,967 colonies of fungi was isolated during this study; 1,344 of the total colonies (approximately 70 percent) consisted of the four fungi previously mentioned. The distribution and frequency of isolation of these four fungi according to crop (averages of all sampling depths and sampling dates) are graphically presented in figure 1.

Striking differences in distribution and frequency of isolation of these four fungi were associated with the particular crops. From the oat plot soil samples *Aspergillus fumigatus* was the predominant fungus isolated and accounted for 64 percent of the total fungi isolated from oat soil. From the corn plot soil samples *Penicillium funiculosum* was the predominant fungus isolated and accounted for 57 percent of the total fungi isolated from corn soil. No one fungus predominated in isolations from the wheat plot soil; instead *Aspergillus fumigatus*, *Trichoderma spp.*, and *Fusarium spp.* were isolated with approximately equal frequency. *A. fumigatus* accounted for 13 percent, *Trichoderma spp.* for 21 percent, and *Fusarium spp.* for 16 percent of the total fungi isolated from the wheat soil. Collectively, from wheat soil these three fungi accounted for 50 percent of the total fungi.

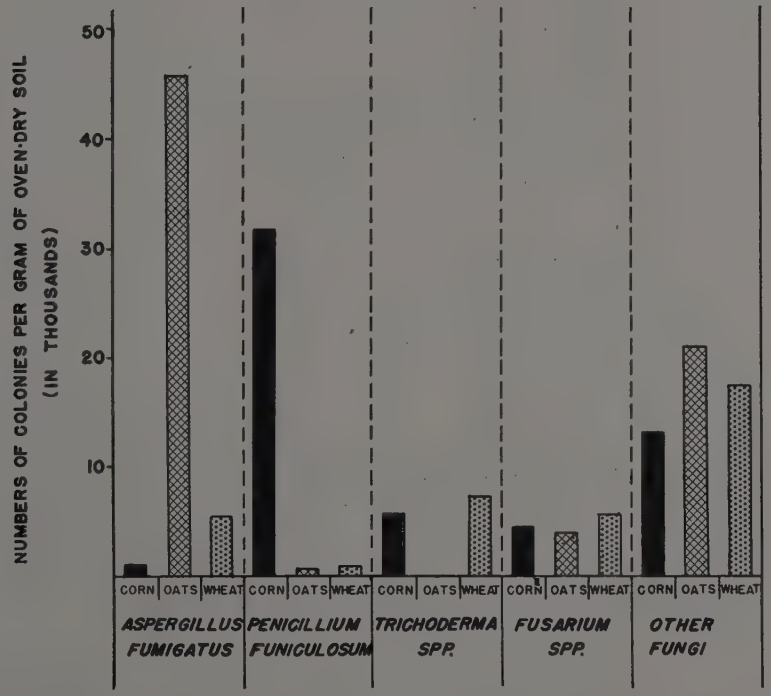

FIGURE 1. Average frequency of isolation (average of all sampling depths and sampling dates) of the four predominate fungi, as well as all other fungi combined, from each of the three plots, corn, oats, and wheat.

With the exception of *Trichoderma spp.*, which were never isolated from the oat plot samples, these four fungi were, at least occasionally, isolated from every plot. Thus, the distinctiveness of the mycoflora associated with each of the three crops was primarily due to the relative frequency of isolation of these fungi and not to their complete absence. The differences in distribution and frequency of isolation of these fungi existed at all sampling depths and on all sampling dates (fig. 2) although fluctuations associated with sampling depths and dates occurred. The experimental design was such that these fluctuations which were apparently

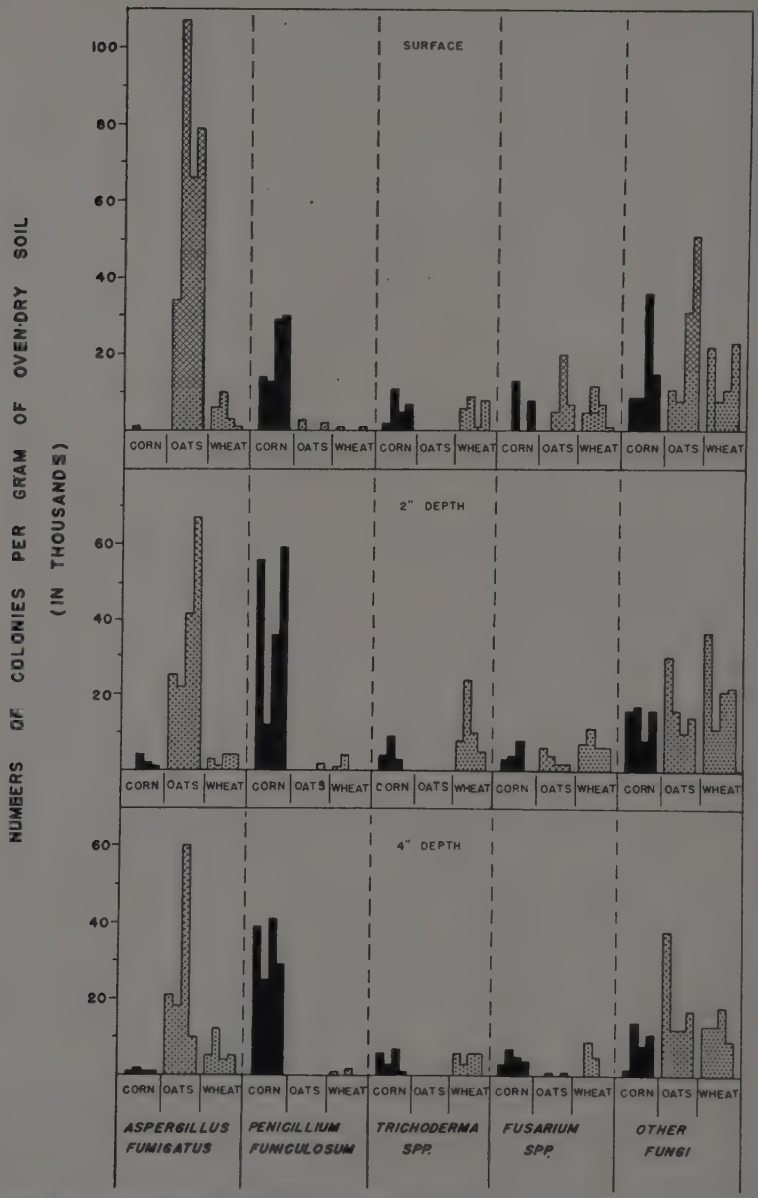

FIGURE 2. Distribution and frequency of the predominate fungi, and all other fungi combined, isolated from the corn, oats, and wheat plots for each sampling date and each sampling depth. Each of the four bars drawn for each crop and a given fungus refers to a sampling date, the bar on the left representing the first sampling date, the next bar the second sampling date, etc. The sampling dates were June 30, July 7, August 18, and September 11.

TABLE 1

List of the kinds of fungi isolated and the total numbers of each isolated from the corn, oats, or wheat plots. Fungi listed in order of frequency of isolation

Fungi	Corn	Oats	Wheat
Aspergillus fumigatus	13	551	58
Penicillium funiculosum	383	7	10
Fusarium spp.	55	48	69
Trichoderma spp.	58		92
Cladosporium spp.	14	22	8
Oospora spp.	1	28	4
Alternaria spp.	4	23	2
Penicillium nigricans	9	5	13
Tilachlidium spp.	1	22	
Monilia spp.	13	2	6
Penicillium oxalicum	14	2	5
Penicillium lilacinum	3	3	14
Acrostalagmus spp.	6		10
Hyalopus spp.	1	2	13
Rhizopus spp.	1		15
Phoma spp.	6	9	
Spicaria spp.	7	2	6
Rhizoctonia spp.	6	3	5
Sacchromyces spp.	4	9	1
Monotospora spp.			10
Penicillium janthinellum	9		1
Gliocladium spp.		1	7
Monosporium spp.	1	2	5
Scopulariopsis spp.		8	
Sporotrichum spp.	2	3	3
Chaetomium spp.		4	3
Papularia spp.			6
Hormiscium spp.		3	2
Mucor spp.	3	1	1
Spondylocladium spp.		5	
Penicillium purpurogenum			4
Cylindrocarpon spp.	1	1	1
Penicillium herquei			3
Penicillium implicatum		3	
Verticillium spp.	1		2
Aspergillus clavatus			2
Cylindrophora spp.	2		
Penicillium canescens	2		
Penicillium citrinum	2		
Penicillium pallidum	1	1	
Penicillium turbatum	2		
Ustilago spp.	2		
Acremonium spp.			1
Aspergillus niger	1		
Aspergillus ustus			1
Aspergillus versicolor			1
Botrytis spp.		1	
Botrytrichum spp.	1		
Cephalosporium spp.	1		
Cepahlothecium spp.		1	
Ciliciopodium spp.			1
Cunninghamella spp.		1	
Mycogone spp.			1
Papulospora spp.	1		
Pestalotia spp.	1		
Pullularia spp.	1		
Stachylidium spp.		1	
Stemphylium spp.	1		
Trichotheeium spp.			1
Unidentified colonies	35	84	53
Totals	669	858	440

due to sampling depths and dates could not validly be evaluated. It was found that the total kinds of fungi (genera, groups, or series) isolated decreased with increased sampling depth; thus, 43 genera, groups, or series were found at the surface, 38 at the 2-inch depth, and 35 at the 4-inch depth.

In table 1 a complete list of the kinds of fungi isolated and the numbers of colonies of each fungus isolated from each of the three plots during this study is given. A total of 59 genera, groups, or series was isolated from all the plots. Thirty-eight genera, groups, or series were isolated from corn soil; 31 from oat soil; and 37 from wheat soil. The unidentified category accounted for approximately 9 percent of the total fungi isolated.

2. *Total fungus colony counts.* As previously mentioned, Kommedahl and Brock (1954) assayed these same continuously cultivated plots during the growing season of 1952 and found that the total fungus colony counts from the oat plot were consistently significantly higher than those from the corn or wheat plots.

TABLE 2

Total colony counts (per gram of over-dried soil) of fungi isolated from corn, oats, or wheat plots at surface, 2-inch and 4-inch depths on the different sampling dates

Sampling Date	Depth	Colonies per gram oven-dried soil		
		Corn	Oats	Wheat
June 30	Surface	26,000	48,000	42,000
	2-inch	85,000	64,000	59,000
	4-inch	57,000	63,000	26,000
July 7	Surface	49,000	122,000	47,000
	2-inch	52,000	45,000	60,000
	4-inch	57,000	34,000	46,000
August 18	Surface	72,000	119,000	25,000
	2-inch	63,000	57,000	47,000
	4-inch	66,000	78,000	42,000
September 11	Surface	62,000	142,000	36,000
	2-inch	84,000	92,000	42,000
	4-inch	50,000	27,000	26,000

All their samples were taken at a depth of 2 inches and the same dilution and plating procedure was used as that employed in this work. The total colony count data for this present study are given in table 2. The total colony counts from the oat plot were consistently higher than those from the corn or wheat plots at the surface sampling depth, but were not consistently higher at the 2 and 4-inch sampling depths. It should be noted that the assays of Kommedahl and Brock were made earlier in the growing season than were the assays in this study. This may account for the conflicting data obtained at the 2-inch sampling depth. It seems reasonable that the relative numbers of the kinds of fungi comprising total counts are of more importance in regard to the incidence of root rots than are the total numbers themselves.

DISCUSSION

In the past, several workers have suggested or reported that there are differences in microflora from the same type of soil cropped to different plants. According to a review by Katznelson *et al.* (1948) the Russian worker Zukovskoya reported that potatoes, flax, and clover growing in the same soil enhanced their own specific microflora. Timonin (1941) found differences in the relative numbers of certain

fungi in "artificial rhizosphere" studies with two varieties of flax. Bisby *et al.* (1933) reported that there are definite differences in the mycoflora from the same type of soil cropped to different plants. Katznelson *et al.* (1948) stated ". . . there are suggestions that different plant species or even varieties may favor development of a specific rhizosphere microflora, but much more work is required before this can be regarded as established."

In the study reported in this paper it was found that the mycoflora of each of three plots, continuously cultivated to either corn, oats, or wheat for 38 years, were characterized by differences in the relative frequency of isolation of four major fungi. It is readily admitted that these continuously monocropped plots represent an unusual and unique cropping situation. They also represent the simplist possible cropping sequence, a desirable condition for preliminary investigations of such a complex problem as soil mycoflora studies. Viewed in the light of the continuing research on soil mycoflora by other members of the Department of Botany and Plant Pathology of The Ohio Agricultural Experiment Station, the choice of the simple continuous plots was indeed fortunate at that stage of the research program. The mycoflora of the continuously cropped plots had reached a degree of stability which made the simple techniques used satisfactory; whereas, new techniques (particularily sampling techniques) and methods had to be developed for the study of more complex cropping sequences. (These new techniques as such are not yet published. References to them were made by Williams and Schmitthenner, 1956; Deems, 1956; and Deems and Young, 1956). Furthermore, it should not be inferred that mycoflora under more complex cropping sequences necessarily bear any relation to those found in this study on the monocropped, nitrogen-deficient continuous plots.

Since the completion of this study in 1953, Deems (1956) and Deems and Young (1956) reported that corn, alfalfa, oats, and sugar beets each developed a characteristic mycoflora during one cropping season (the immediate preceding cropping history of the field was two years of sugar beets). The mycoflora were characterized by the relative frequency of isolation of certain fungi from the variously cropped plots rather than the presence or absence of these fungi. The differences in mycoflora were correlated with increase or decrease in the incidence of black root of sugar beets. As well may be expected, considering the contrasting cropping histories, the work of Deems differed in several respects from that reported in this paper. *Trichoderma spp.* were never isolated from oat soil under continuous cropping; whereas Deems found *Trichoderma viride* to be one of the dominant fungi under oats. The dominant fungi from the monocropped oats and corn plots sampled in this study constituted a greater percentage of the total fungi isolated from each of these plots than did the dominant fungi under given crops in the work of Deems.

Of more interest than the differences between this work and that of Deems are the similarities. *Penicillium funiculosum*, the predominant fungus from monocropped corn soil, was also found to be a characteristic dominant fungus under corn by Deems. *Aspergillus fumigatus*, the predominant fungus under monocropped oats, was also found in relatively large numbers under oats by Deems. In regard to these similarities, Menon (1956) studied the effects of temperature, moisture, and cropping on soil mycoflora and reported that the primary factor influencing soil mycoflora was the crop.

In the opinion of the author, which is also shared by Deems (1956), the kinds of fungi and the relative frequency of their isolation under different crops are of more importance in relation to incidence of root rots than are the total numbers of fungi isolated under the various crops. Since the major fungi (those isolated in the largest numbers) generally are found under all the crops, it is essential that quantitative methods be used, such as the soil dilution plate method, instead of qualitative methods since the principal differences in soil mycoflora are quantitative not qualitative with respect to kinds of fungi.

SUMMARY

Soil from three plots cropped continuously since 1915 to either corn, oats, or wheat was assayed by the dilution-plate technique for numbers and kinds of fungi. The fungi were identified to genus, except for the Penicillia and Aspergilli which were identified to series and groups respectively.

From the three plots four kinds of fungi predominated in the isolations; *Aspergillus fumigatus, Penicillium funiculosum, Trichoderma spp.*, and *Fusarium spp.* Marked differences in the distribution and frequency of isolation of these four fungi were found to characterize the mycoflora under each of the three crops. *Aspergillus fumigatus* was the predominant fungus isolated from the oat plot; *Penicillium funiculosum* was the predominant fungus isolated from the corn plot; whereas, no one fungus predominated in the isolations from the wheat plot; instead, *Aspergillus fumigatus, Trichoderma spp.*, and *Fusarium spp.* were approximately equal in frequency of isolation.

These differences in mycoflora under the crops consisted primarily of differences in the relative frequency of isolation of the major fungi rather than to their complete absence (with the exception of *Trichoderma spp.* which were never isolated from the oat plot).

In contrast to the findings of Kommedahl and Brock (1954), the numbers of fungi isolated from the plots at the 2-inch depth were not found to be consistently higher from the oat plot.

ACKNOWLEDGMENT

The writer wishes to express his sincere gratitude to Dr. Thor Kommedahl for his invaluable help in regard to the identification of the fungi and for other assistance.

LITERATURE CITED

Bisby, G. R., N. James, and **M. I. Timonin.** 1933. Fungi isolated from Manitoba soil by the plate method. Can. Jour. Res. 8: 253–275.

Broadfoot, W. C. 1934. Studies on foot and root rot of wheat. III. Effect of crop rotation and cultural practice on the development of foot rot of wheat. Can. Jour. Res. 10: 115–124.

Clark, F. E. 1949. Soil microorganisms and plant roots. Adv. in Agron. 1: 241–288.

Clements, F. E. and **C. L. Shear.** 1931. The Genera of Fungi. 496 pp. H. W. Wilson Co., New York.

Deems, R. E. 1956. Black root of sugar beets as influenced by various cropping sequences and their associated mycofloras. 217 pp. Ph.D. dissertation. The Ohio State University, Columbus, Ohio.

——— and **H. C. Young.** 1956. Black root of sugar beets as influenced by various cropping sequences and their associated mycofloras. Jour. Am. Soc. of Sugar Beet Technologists. 9: 32–43.

Garrett, S. D. 1944. Root Disease Fungi. 177 pp. Chronic Botanica Co., Waltham, Mass.

Gilman, J. C. 1945. A Manual of Soil Fungi. 392 pp. Collegiate Press, Inc., Ames, Iowa.

Katznelson, H., A. G. Lochhead, and **M. I. Timonin.** 1948. Soil microorganisms and the rhizosphere. Bot. Rev. 14: 543–587.

Kommedahl, T. and **T. D. Brock.** 1954. Studies of the relationship of soil mycoflora to disease incidence. Phytopathology 44: 57–61.

Lochhead, A. G. 1952. Soil microbiology. Ann. Rev. Microbiol. 6: 185–206.

Menon, S. K. 1956. Some factors influencing soil mycofloras. 72 pp. Ph.D. dissertation, The Ohio State University, Columbus, Ohio.

Odland, T. E., R. S. Bell, and **J. B. Smith.** 1950. The influence of crop plants on those which follow. V. Rhode Island Exp. Sta. Bull. 309.

Raper, K. B. and **C. Thom.** 1949. Manual of the Penicillia. 875 pp. Williams and Wilkins Co., Baltimore, Md.

Sanford, G. B. 1946. Soil-borne diseases in relation to the microflora associated with various crops and soil amendments. Soil Sci. 61: 9–21.

Simmonds, P. M. 1953. Root rots of cereals II. Bot. Rev. 19: 131–146.

Thom, C. and **K. B. Raper.** 1945. Manual of the Aspergilli. 373 pp. Williams and Wilkins Co., Baltimore, Md.

Timonin, M. I. 1941. The interaction of higher plants and soil microorganisms III. Effect of by-products of plant growth on activity of fungi and actinomycetes. Soil Sci. 52: 395–408.
Tyner, L. E. 1948. Effect of crop debris, plant roots, and crop sequence on the microbial flora of the soil in relation to root rot in cereal crops. Can. Jour. Res. (C) 26: 86–93.
Waksman, S. A. 1952. Soil Microbiology. 356 pp. John Wiley and Sons, Inc., New York.
Warcup, J. H. 1950. The soil-plate method for isolation of fungi from soil. Nature 166: 117–118.
Weindling, R. 1946. Microbial antagonism and disease control. Soil Sci. 61: 23–30.
——— **H. Katznelson,** and **Helen P. Beale.** 1950. Antibiosis in relation to plant diseases. Ann. Rev. of Microbiol. 4: 247–260.
Williams, L. E. and **A. F. Schmitthenner.** 1956. Genera of fungi in Ohio soils. 7 pp. Ohio Agric. Exp. Sta. Res. Circ. 39.

Ferns of Ohio. *Harry H. Vannorsdall.* Distributed by Curtis Book Store, Wilmington, Ohio. 1956. vi+298 pp. $3.00.

Learning to know the ferns of Ohio will be fascinating indeed to anyone who has this book to help him. The description of each species is accompanied by three excellent photographs—the fern in its usual habitat, a leaf or a whole plant, and a close-up of a leaf in which details of sori, venation, and other characters essential to identification are evident.

The author states in the preface that the book is intended for amateurs, but all students of ferns whether as hobbyists or as professional botanists will find it useful and enjoyable. It can be used alone or with the standard manuals. Especially helpful to the teacher will be the photographs and the hints on how to distinguish species that are similar in appearance.

Dr. Vannorsdall's attractive book may well serve as a model for similar ones about other plant groups.

CLARA WEISHAUPT

Dust for the Dancers. *Beth Dean* and *Victor Carell.* Philosophical Library. New York. First Edition. Copyrighted by authors, 1955, and printed and bound in Australia. 1956. x+214 pp. $6.00.

The authors are a husband and wife dancing team who, seeking new ideas for interpretative dancing, made a 10,000 mile tour of camps of Australian aboriginees. They spent several months among various tribes, observing the landscape and the ways of living, and they were able to see and record the techniques and meanings of dances. The title derives from the dancing grounds, where the soil becomes powdery as result of pounding by dancing feet.

There are dances to portray tribal concepts of Creation, dances by men about hunting, fishing, fighting and gossiping, dances by women about love-making and childbirth, and ceremonial dances for the attainment of maturity by boys and girls. This record is timely because the culture of the aboriginees seems foredoomed by the expansion of whiteman culture.

Social anthropologists and geographers will find much of value in the well written text and excellent photographs.

THOMAS H. LANGLOIS

Journal of Insect Physiology. *V. G. Dethier, H. E. Hinton,* and *M. Lüscher,* Eds. Pergamon Press, London, New York, & Paris. 1957. Volume I (four issues). $17.00 to libraries and institutions; $9.80 to private individuals.

This new periodical reflects the ever increasing interest in the specialized field of insect physiology. Organized on an international basis it will include papers that "contribute to an understanding of the general principles underlying the physiology of insects." A glance at the abstracts of papers for the first issue indicates that seven are in English, one in French. The policy on language of publication is not stated in the descriptive leaflet. The double price standard appears to demonstrate either an unusual concern for the individual scientist or a concept that research institutions and libraries are well fixed for funds and should take a larger share in the support of this fledgling journal.

F. W. FISK

THE DETECTION AND SEPARATION OF PECTIC SUBSTANCES BY PAPER CHROMATOGRAPHY AND PAPER ELECTROPHORESIS

LUDWIK UJEJSKI[1]

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The great interest in pectic substances makes the development of new techniques for detection and identification of these compounds highly desirable. However, the heterogeneity of these substances causes difficulties in their characterization.

Paper chromatography has been successfully applied for the separation of various degradation products of pectic substances. These degradation products are obtained by acid or enzymatic hydrolysis and more recently by heating with the cation exchange resin, Permutit Q, in a sealed tube.

The last method of hydrolysis yields a solution of galacturonic acid, oligogalacturonides, galactose, arabinose, and rhamnose as detected by chromatography.

A general chromatographic method for the detection and separation of pectic substances has not been developed till now. The aim of this paper is to present a method for chromatographic and electrophoretic separation on paper of different pectin preparations.

The method to be described was based on the following properties of pectic substances:

1. The relative solubility of pectinic acid (pectin) in water and its insolubility in ethanol suggested that either water (buffer) or a mixture of ethanol-water could be used as solvent for paper chromatography of pectin.

2. Pectin is thought to consist mainly of polygalacturonic acid esters. These should give similar reactions as carboxylic acid esters.

The use of hydroxylamine in alkaline solution to convert polygalacturonic acid esters into hydroxamates followed by ferric chloride as color reagent appeared to be promising for the detection of esterified polygalacturonic acid units (Whittaker and Wijesundera, 1951).

3. Pectic substances show a relatively high mobility in electrophoresis (Tiselius and Ingelman, 1942; Speiser, Copley and Nutting, 1947). This suggested that after the migration in an electric field the pectic substances could be detected by spraying the paper with hydroxylamine-ferric-chloride reagent.

EXPERIMENTAL PROCEDURE

Material and methods.—The following substances were used: pectin N.F., pectin N.F. heated for 8 hours in 1 percent solution, 1 percent solution of pectin N.F. heated for 24 hours, pectin obtained from bean leaves by extraction with 0.5 percent of ammonium oxalate and radioactive pectin.

Radioactive pectin was prepared as follows:

Fourteen mature bean leaves, fresh weight 5.29 gms., were placed in a desiccator with petioles immersed in water. $C^{14}O_2$ generated from 1 mg. Ba $C^{14}O_3$ by lactic acid was passed into the desiccator, and the apparatus was allowed to to remain in the light for 20 hours.

The leaves were then put into boiling 95 percent ethanol, boiled for 10 minutes, and dried in a vacuum oven for 5 hours at 60°C.

[1]Present address: The Ogilvie Flour Mills Co. Ltd., Research Department, Montreal, Canada.

The dried material was extracted with 0.5 percent ammonium oxalate three times for 6 hours.

Pectin was precipitated by adding 1 volume of acetone and 200 to 300 mg. percent of sodium chloride.

After 2 hours, the acetone-water layer was decanted and about 60 cc. of a colloidal suspension was centrifuged at 5000 r.p.m.

The residue was dissolved in 10 cc. of water, centrifuged and reprecipitated with 10 cc. of acetone.

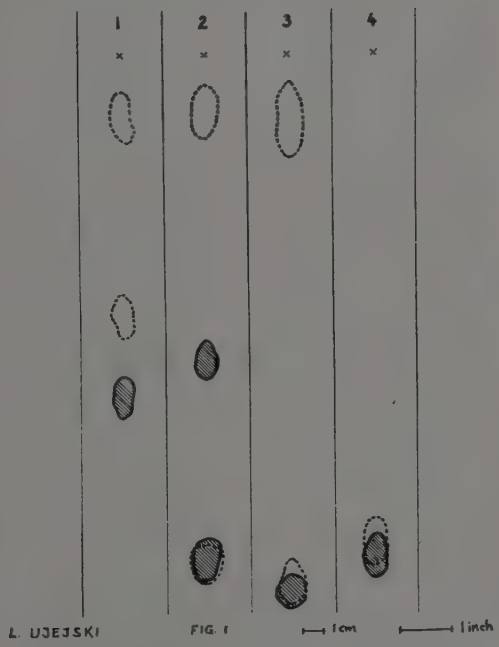

FIGURE 1. Paper chromatography of pectic substances
(1) Pectin N.F.
(2) Pectin N.F. heated for 8 hours
(3) Pectin N.F. heated for 24 hours
(4) Pectin obtained from bean leaves
Dotted circles represent the free acids

FIGURE 2. Autoradiogram of radioactive pectin

Paper chromatography.—No. 3 Whatman filter paper was washed with 0.3 N hydrochloric acid, water, 0.5 N sodium hydroxide, water. The chromatograms were developed with 33 percent ethanol in water v./v. by the descending technique, until the solvent front passed about 6 cm. beyond a pencil mark 3 inches from the upper edge (Boman, 1952). The paper was then quickly taken out, 25 μl. spots of various samples were applied to the pencil mark and the migration continued for 3 hours (fig. 1 and 2).

Reagents.—

Hydroxylamine. Solution **A**: 20 gm. of hydroxylamine hydrochloride were dissolved in 50 ml. of water and diluted to 200 ml. with ethanol; Solution **B**:

50 gm. of potassium hydroxide in a minimum of water were diluted to 500 ml. with ethanol. After mixing the solutions A and B, potassium chloride was removed.

Ferric chloride. 10 gm. of $FeCl_3 \cdot 6H_2O$ were dissolved in 20 ml. of 10 N HCl and the solution shaken with 300 ml. of ether until homogeneous.

The strips were sprayed with ethanolic solution of hydroxylamine, dried at room temperature for 15 minutes, then dipped into an ethereal acid solution of ferric chloride and immediately washed under tap water until the background became white.

Well developed purple spots were formed showing the position of esters.

A spray, consisting of a solution of 50 mg. bromophenol blue in 100 mg. of 95 percent ethanol adjusted to pH 6.5 with sodium hydroxide, revealed the positions occupied by free acids.

Paper electrophoresis.—Spinco paper electrophoresis cell, Durrum type, and strips of Whatman 3 mm. filter paper 30 mm. wide were used. The strips were saturated with acetate buffers (0.2M solution) of different pH values: 3.6, 4, 4.6, 4.9, 5.5.

0.01 ml. of 1 percent solutions were applied to strips.

Satisfactory migration was observed (fig. 3) when a constant voltage of 200 V, D.C., was maintained for three and one-half hours.

The bands were then detected by means of hydroxylamine-ferric chloride reagent (fig. 3).

No migration was observed at pH 5.5.

RESULTS AND DISCUSSION

Thirty-three percent ethanol-water solution used as solvent for development of chromatograms of pectic substances combined with the technique of Boman (1952) appeared to be the most suitable.

Besides this solvent, numerous other solvent systems were tried. Gylcerol-water, glycerol-ethanol, dioxane-water, furfuryl achohol-water, pyridine-water produced tailing spots.

Better chromatograms were obtained with 12 percent ethanol-water with addition of 200 mg. of NACl.

Hydroxylamine-ferric chloride reagent gives well defined spots with amounts as low as 30 micrograms of pectin.

The chromatograms sprayed with the hydroxylamine-ferric chloride reagent displayed the following spots (fig. 1).

Strip No. 1 is a chromatogram of unheated 1 percent solution of pectin N.F. It shows one slow moving spot.

Strip No. 2 is a chromatogram of the same pectin solution but heated 8 hours on a water bath. It displays two spots. The slower moving spot has the same rate of migration as the spot on strip No. 1.

Strip No. 3 is a chromatogram of 1 percent solution of pectin N.F. heated for 24 hours on a water bath. This strip shows a single fast moving spot whose position corresponds to that of the fast moving spot of strip No. 2.

Strip No. 4 represents the chromatogram of pectin obtained from bean leaves. Again there is only one spot corresponding in position to that of the fast moving spot on strips No. 2 and 3.

Figure 2 is an autoradiogram of radioactive pectin. The rate of migration of the fast moving spot is similar to that of strip No. 3.

The differences in movement on paper of heated and unheated samples are probably due to physio-chemical changes in pectin macro-molecules.

It has been generally observed that heated pectin solutions exhibit a rapid decrease in viscosity. According to the theory of Kertesz (1951), the structure of

FIGURE 3. Paper electrophoresis of pectic substances

(A) Pectin N.F.
(B) Pectin N.F. heated for 8 hours
(C) Pectin obtained from bean leaves
(D) Pectin N.F. heated for 24 hours

pectin solutions might be expressed by the formula [(Gm)] n, where Gm represents a polymer of m galacturonic acid units and forms aggregates containing n of these units held together by secondary valence forces. These secondary aggregates are thought to be mainly responsible for the high viscosity of pectin solutions, whereas losses of viscosity occurring during heating are due to the destruction of these aggregates held by secondary forces.

In agreement with this theory, the slow moving spots on the chromatograms of unheated and heated solutions (8 hours) might correspond to the secondary aggregates, and the fast moving ones to the molecules after disruption of the secondary valence forces.

Dotted circles on figure 1 represent the detection of free acids in different pectin preparations by means of bromophenol blue reagent.

All strips except No. 4 (pectin from bean leaves) and radioactive pectin show two yellow spots on blue background. The position of the second faster moving spot is the same as that of the ester units; this would indicate a partial deesterification.

Figure 3 shows electrophorograms of the pectin preparations.

The method herein described is the first successful adaptation of conventional paper chromatography and paper electrophoresis to the detection and separation of pectic substances. It is believed that it represents useful techniques for the characterizing of these scientifically and commerically important substances.

SUMMARY

A new procedure is presented for the detection and separation of pectic substances which have been separated by paper chromatographic and electrophoretic methods.

Hydroxylamine in alkaline solution, converting polygalacturonic acid esters into hydroxamates followed by ferric chloride as color reagent, was used for the detection of pectic substances on paper.

Bromophenol blue (pH = 6.5) was applied for location of free carboxylic acids.

ACKNOWLEDGMENT

I am grateful to Doctor Gunter Zweig of the Charles F. Kettering Foundation, Yellow Springs, Ohio, for his valuable suggestions and kind interest during the experimental work.

LITERATURE CITED

Boman, H. G. 1952. Double fronting in paper chromatography of proteins. Nature 170: 703.
Kertesz, Z. I. 1951. The Pectic Substances. p. 53. Inter-science Publisher Inc., New York.
Speiser, R., M. J. Copley, and **G. C. Nutting.** 1947. Effect of molecular association and charge distribution on the gelation of pectin. Jour. Phys. and Colloid. Chem. 51: 117.
Tiselius, A. and **B. Ingelman.** 1942. Förh. Svenska Socker, II, 16 pp.
Whittaker, V. P. and **S. Wijesundera.** 1951. Separation of esters of choline by filter-paper-chromatography. Biochem. Soc. Proc. p. xvi (bound with Biochem. Jour. vol. 49).

CYCLONIC AND FRONTAL ACTIVITY IN OHIO DURING THE SUMMER OF 1953

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The summer of 1953 was an unusually dry one in most of southern United States and parts of the midwest. The state of Ohio had one of its driest summers in several decades in 1953. A cross section of the state's weather may be seen in the statistics for Cleveland, Columbus, and Cincinnati, these stations being located in the north, central, and south parts of the state respectively. An average of the normal precipitation for these three stations during the period June 1 to September 30 is 13.39 inches. In 1953 the average precipitation for these stations was 10.04 inches for the summer (Clim. Data, 1953), 26 percent below normal. Individual stations may frequently have a commensurate or greater variation from one year to the next; but when several stations in the same part of the country show a similar variation in one season, a variation in warm season climate is indicated.

Several authors (Winston, 1953; Klein, 1953a; Klein, 1953b) have noted that a pronounced anticyclonic circulation associated with the subtropical high pressure cell dominated the upper air over southern United States much of the summer and was immediately associated with the drought of that summer. A contributory cause was the prevailing direction of the upper air winds which was such as to restrict clashes between Continental Polar and Maritime Tropical air masses over the United States.

This study is not concerned with the upper air. Instead, the emphasis here is on the surface situation as shown by weather maps. It is felt that a consideration of day by day surface weather might lead to a fuller understanding of the warm season climate of the area in question.

In order better to see the summer of 1953 in its proper perspective, a comparison of cyclonic activity during that summer and one or two during which precipitation was near normal or above should be helpful. It is the purpose of this paper to make such a comparison.

The summers of 1947 and 1956 are used for comparison. The year 1947 had the wettest summer in Ohio in the past decade, the average rainfall for the three stations being 16.26 in. from June 1 to September 30 (Clim. Data, 1947), or 21 percent above the long term average. The summer of 1956 is included as an additional comparative year, the rainfall that summer being within 3 percent of the long term average (Clim. Data, 1956).

The stations selected for the study each have a length of record of over 40 years. The comparison of summer precipitation for a given year with an average utilizes long term averages as of 1953. The area of primary concern is the State of Ohio. Although political boundaries and climatic regional boundaries seldom coincide, the writer does not feel that this fact renders invalid a study of the climate of a politically defined area. There is no attempt made here to suggest that the conditions discussed are peculiar only to Ohio nor to any particular climate type.

Paths of Cyclones

Of primary consideration in a comparative study such as this are the storm tracks or paths followed by cyclones during the years in question. Although the area of principal attention remains as defined, cyclones may often be centered

outside that area and still affect it. Hence, figures 1, 2, and 3, show all cyclones occuring in eastern North America between latitudes 30° N and 60° N and east of longitude 90° W. Many of the northernmost cyclones would not affect Ohio; they are included in the interest of a more complete picture. These maps were compiled from monthly maps of cyclone tracks (Mo. Wea. Rev., 1947, 1953, 1956). Figure 4 summarizes the three maps of cyclone paths. Inasmuch as the number of cyclones is variable from year to year, the graph shows the *percentage* of cyclones crossing the 85th meridian in each of several zones, four degrees of latitude

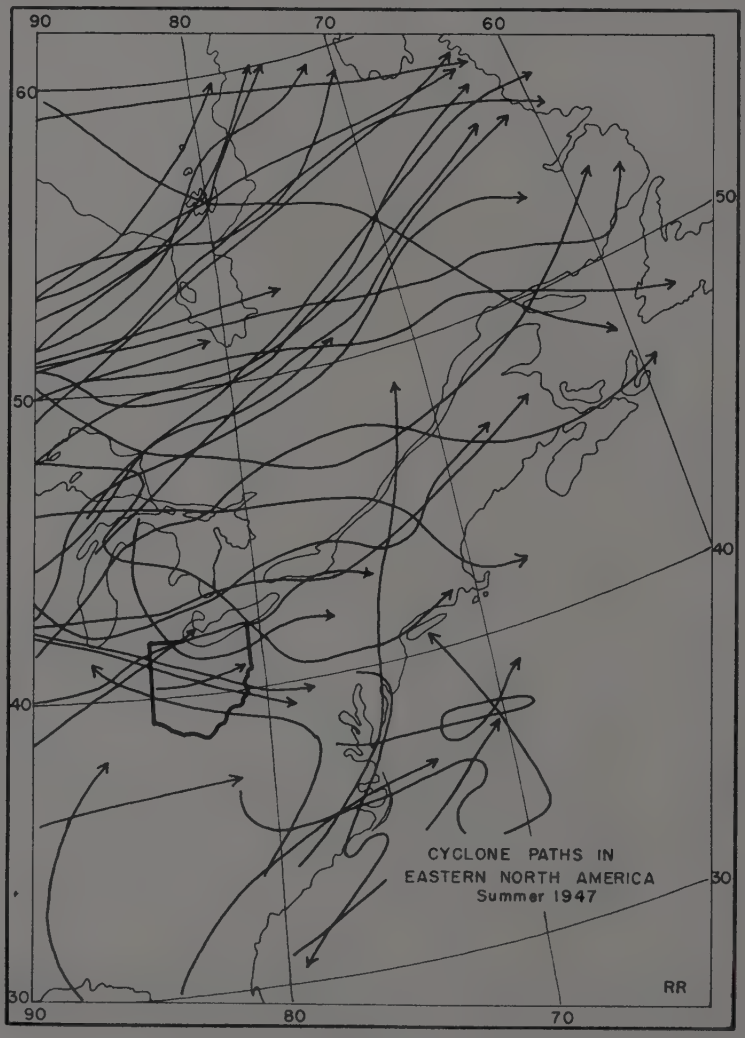

FIGURE 1

in width. Of the variety of choices of latitude units possible, a four degree unit was chosen because it approximates Ohio's latitudinal width. Similarly, since Ohio's north and south boundaries lie within one half of a degree of the 42° and 38° parallels respectively, this four degree unit formed the numerical basis for the selection of the other latitude units.

It will be seen from the graph that 1947 and 1956 have a maximum in or just north of Ohio. In 1953 this maximum is less pronounced and is farther poleward while the major concentration is along the south edge of Hudson Bay. The

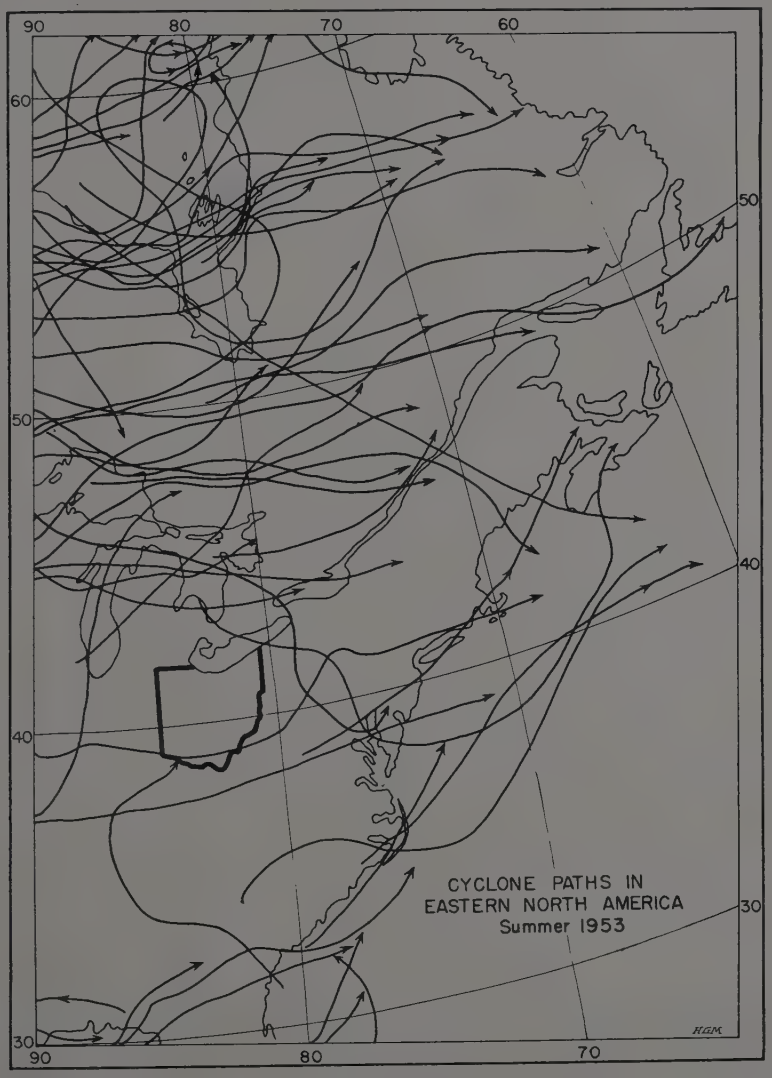

FIGURE 2

years 1947 and 1953 are alike in having two maxima, but those of 1947 are closer to Ohio and more nearly equal. The pronounced single maximum of 1956 would seem to suggest an even wetter summer in Ohio than 1947. The first three months of the warm season averaged above normal precipitation, but the markedly reduced rainfall at all three stations in September had its effect on the four months total.[1] It may also be noted that there was a greater percentage of cyclones at Ohio's

[1]It may be noted here that the upper air situation of September, 1956 has been likened to that of September, 1953 (Hawkins, 1956).

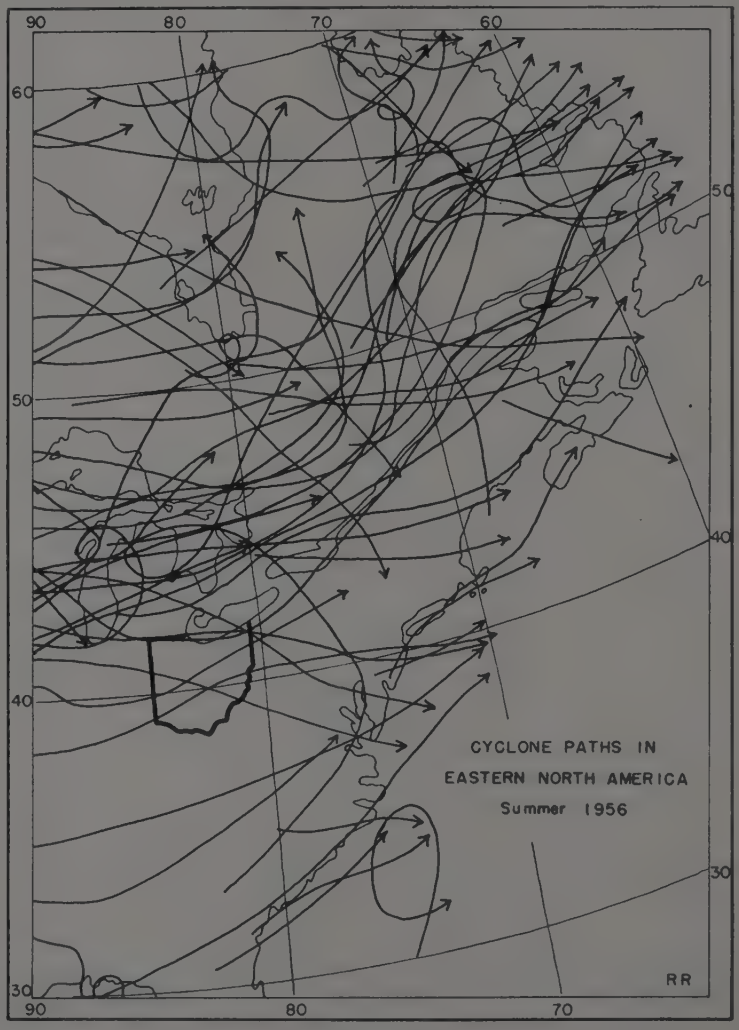

FIGURE 3

latitude in both of the wet years than during the dry year. In short, it would seem that coincident with the occurrence of a drier-than-average summer there was a comparative dearth of cyclonic activity in or near Ohio. If we can assume that, in general, the amount of precipitation decreases as distance from the low center increases, the above consideration of surface weather suggests that Ohio in 1953 was drier than the other two years partly because of the greater remoteness of most of that summer's cyclones.

Precipitation Types

It is common to find cyclonic precipitation considered along with frontal precipitation as opposed to that due to other causes such as convection, etc. This is, of course, in recognition of the fact that much precipitation which occurs with the passage of a cyclone is more directly due to its associated fronts than to

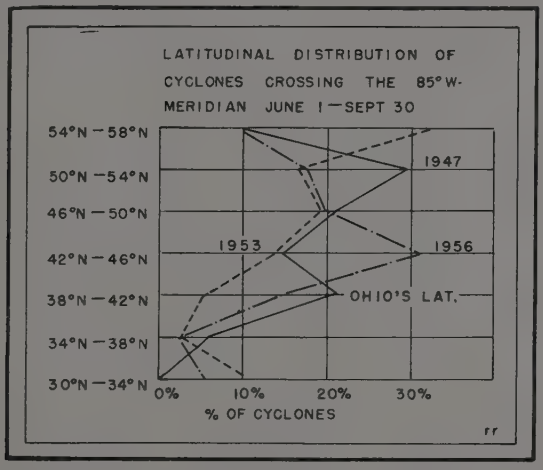

FIGURE 4

the low center itself. In like manner frontal and cylonic precipitation are considered jointly in this study, and the terms frontal and cyclonic are used interchangeably. It is recognized that not all warm season precipitation is necessarily due to fronts and cyclones, that some may be due to other causes. It is in fact possible that the differences in summer rainfall mentioned at the beginning of this paper are, for example, differences in the amount of convective rainfall. It therefore becomes necessary to determine how much of the summer rainfall in Ohio is associated with fronts and cyclones and how much is due to other causes. Since this study is concerned primarily with the former type, no attempt will be made to identify as to cause rainfall that is not frontal or cyclonic. It will be referred to hereafter simply as "other."

The problem of differentiating between frontal and other rainfall may seem straight forward enough at first; however, in the course of considering all rainfall that occurs at a number of stations—especially during the summer months—problems do arise. In studying the dates on which rainfall occurred at these stations and daily weather maps for the same dates, it was noted that the majority of rainy days were days when a front or a cyclone was in the near vicinity of the station. A rather broad interpretation of the word frontal is used herein, partly because of the aforementioned fact, and partly because it is felt that a thorough pursuance of the matter is a separate study in itself. The word frontal will be used hereafter to refer to precipitation occurring within the general limitations

set out below. Experiments employing arbitrary distance limits from cyclones or fronts proved unsatisfactory and were discarded.

On the Daily Weather Map of recent years, the main map and two of the smaller maps may be used to obtain a fairly continuous picture of surface weather. By combining the information on the large map with that on the small map showing the synoptic situation 12 hours earlier, a sequence of frontal movements can be obtained. Another small map shows areas where precipitation occurred during the 24 hours prior to the time of the large map. In many cases the striking coincidence between the *pattern* and location of the precipitation area and the area through which fronts moved during the period in question seems to indicate the cause of the precipitation. Admittedly the picture is often not as clear cut as is desirable; naturally occurring phenomena often leave much to be desired in this respect. Locations near the margins of affected areas require arbitarary decisions. However, where the station in question lies within an uninterrupted area of precipitation, which area has experienced a frontal passage or cyclonic activity during the same time interval, all precipitation at the station is herein classified frontal.

TABLE 1

Amount and type of precipitation June 1 to September 30

FRONTAL PRECIPITATION	1947	1953	1956
Cleveland	16.82	11.61	13.03
Columbus	15.28	7.36	10.85
Cincinnati	11.49	5.79	10.88
Average	14.53	8.25	11.59
% of Average Total	89	86	84
OTHER PRECIPITATION	1947	1953	1956
Cleveland	1.64	.21	1.55
Columbus	2.51	2.12	.84
Cincinnati	1.05	1.74	4.28
Average	1.73	1.36	2.24
% of Average Total	11	14	16

As pointed out earlier, the coincidence between precipitation dates and frontal activity dates is considerable at the stations here discussed. The actual amounts as shown in table 1 illustrate this more specifically. It will be seen that during each of the three years considered, for each of the three stations the amount of frontal precipitation is markedly greater than that which is classified as other. These figures were arrived at by checking each day that precipitation occurred at each station (Clim. Data, 1947, 1953, 1956) against the daily weather map (Daily Wea. Map, 1947, 1953, 1956) and classifying the precipitation as frontal or other as outlined above. The significant difference in the precipitation amounts is the one between 14.53 or 11.59 on the one hand, and 8.25 on the other, an average of 3 to 6 inches less frontal precipitation in the dry summer. Insofar as the other category is concerned, the three Ohio stations averaged only 0.4 inches less in 1953 than in 1947, and 0.9 inches less than in 1956. It would thus seem indicated that the difference in the amount of the other precipitation is, relatively speaking, unimportant here. It is interesting to note that despite the admittedly broad interpretation put on these two categories, the percentages are remarkably close for the three years considered.

The writer was interested in knowing whether there was any difference in the velocity of cyclones during a wet summer as compared to those of a dry summer. Using the aforementioned maps of cyclone tracks in the Monthly Weather Review, an average velocity was computed for each cyclone crossing the 85th meridian between 30° N and 50° N during the summer; and the several figures were com-

bined to obtain an average for the whole summer. A comparison of the averages for the two summers revealed no significant differences, the actual difference between two summers being about 1 m.p.h. Similarly the relative depth of cyclones during two of the summers were compared utilizing Daily Weather Maps. Average pressure gradients for the several cyclones of each summer were obtained by combining distance in miles from the low centers to the associated high pressure centers with the pressure difference across this distance. The average pressure gradient computed for the summer cyclones of 1947 differed from that computed for 1953 by one-tenth of a millibar in 100 miles, hardly a significant figure.

SUMMARY

In comparing cyclonic activity during the several summers here considered, the following points were noted:

1. During the dry summer in Ohio, a majority of the cyclone paths were markedly farther north of the state than during either of the wetter summers.
2. Cyclonic and associated frontal precipitation as herein defined was clearly the dominant type at the three stations considered during both dry and wetter summers.
3. A study of the surface weather maps for these summers therefore suggests that 1953 was drier because more of the effective cyclonic and frontal activity in eastern North America occurred north of Ohio during that summer.
4. No appreciable difference in velocity or relative depth of cyclones in the years considered was noted.

A comment seems in order concerning the percentage of total summer precipitation here described as being associated with frontal or cyclonic activity. Some may feel that the percentage is too high, that more of the summer precipitation is due to other causes such as convectional activity. Others may feel that the percentages should be still higher, that were upper air cyclonic effects taken into consideration an even higher percentage of the precipitation would be so categorized. The latter point of view is not debated here as the emphasis in this study was on weather as shown by surface maps. As regards the other point of view, more definitive criteria for classifying precipitation as to origin and a broader statistical coverage both in years and number of stations should show whether they are representative or not. It is believed that even with the above refinements, cyclonic or frontal precipitation will be found to be clearly dominant.

ACKNOWLEDGMENT

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REFERENCES

Hawkins, H. F. 1956. The weather and circulation of Sept. 1956. Monthly Weather Review 84(9): 338.

Klein, W. H. 1953a. The weather and circulation of Aug. 1953. Monthly Weather Review 81(8): 246–54.

———. 1953b. The weather and circulation of Sept. 1953. Monthly Weather Review 81(9): 305.

U. S. Weather Bureau. 1947. Climatological Data, Ohio. Vol. 52, Nos. 6–9.

———. 1953. Climatological Data, Ohio. Vol. 57, Nos. 6–9.

———. 1956. Climatological Data, Ohio. Vol. 61, Nos. 6–9.

U. S. Weather Bureau. 1947. Daily Weather Map, June 1–Sept. 30.

———. 1953. Daily Weather Map, June 1–Sept. 30.

———. 1956. Daily Weather Map, June 1–Sept. 30.

Monthly Weather Review. 1947. Tracks of centers of cyclones. Vol. 75, Nos. 6–9, Chart III.

———. 1953. Tracks of centers of cyclones. Vol. 81, Nos. 6–9, Chart X.

———. 1956. Tracks of centers of cyclones. Vol. 84, Nos. 6–9, Chart X.

Winston, J. S. 1953. The weather and circulation of June 1953. Monthly Weather Review 81(6): 166.

OXIDATIVE RATES OF HOMOGENATES OF RAT SMALL INTESTINAL EPITHELIUM. EFFECTS OF FASTING AND INTESTINAL LEVEL[1]

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The transport of certain sugars by small intestinal epithelium depends upon a vigorous oxidative metabolism (Darlington and Quastel, 1953; Ponz and Lluch, 1955). Therefore, knowledge of effects of various nutritional states upon rates of oxidation in this tissue is basic to understanding certain effects of nutrition upon at least one of the specialized functions of the epithelium. This paper describes effects of fasting upon oxidative rates of fortified homogenates derived from essentially the entire small intestinal epithelium. Oxidative rates of epithelial homogenates from 3 different levels of the small intestine in fed rats are given also.

METHODS

Mature male Sprague-Dawley rats weighing 196 to 456 g. were maintained on a ration of Rockland Rat Pellets (Complete) and tap water. For trials with fasted rats, pellets (but not water) were withdrawn for 24 hours. The rats were stunned and bled. The entire small intestine was freed from mesentery, excised, and placed in ice-cold 0.25 M mannitol, cleaned (Hele, 1953) and weighed. The entire organ was treated in a homogenizer and the epithelium was freed from other layers as described by Hele (1953) except that ice-cold 0.25 M mannitol solution (5 ml./g. intestine) was used for homogenization. The homogenates contained some whole cells of columnar epithelium, occurring both singly and in sheets, as well as broken cells. The volumes of epithelial homogenates were measured, and aliquots were taken for nitrogen determination by micro-Kjeldahl and for tests of oxidative rate by direct Warburg manometry. The homogenates contained 1.4 to 2.1 mg. nitrogen/ml.

For tests at different levels of intestine, the entire small intestine from rats weighing 347 to 374 g. was laid out and the length measured. The small gut averaged 113 cm. (range: 109–119 cm.) in length. This total length was cut into 3 sections (upper, middle, and lower) of equal length. Each section was cleaned separately to prevent possible cross-contamination by microorganisms, and separate epithelial homogenates were prepared and tested as described above for the whole intestine. These homogenates averaged 2.2, 2.1, and 2.1 mg. nitrogen/ml. in the upper, middle, and lower thirds, respectively; thus, any differences found in simultaneous comparison of the 3 segments could not be due to use of unequal concentrations or amounts of total tissue.

Each Warburg flask contained 1.0 ml. of homogenate and the following (amounts in μmoles): 80 tris (hydroxymethyl) aminomethane·HCl buffer at pH 8.5, 20 potassium phosphate at pH 8.1, 10 $MgCl_2$, 0.03 cytochrome c (Sigma), 12 potassium adenosine triphosphate (Pabst), 2 potassium diphosphopyridine nucleotide (Sigma, 90% pure); α-ketoglutarate (30 μmoles) was added to $\frac{1}{2}$ of the flasks for 6 rats in each group in the fed *vs.* fasted comparison. The total volume was made to 3.0 ml. with 0.15 M KCl. NaOH was used in the center well. The gas phase was air. The cold flasks containing the reaction mixtures were brought to 35° C

[1]Supported in part by a grant from The Ohio State University Development Fund. Approved by the Associate Director of the Ohio Agricultural Experiment Station as Journal article number 16-57.

by shaking in a bath for 10 minutes before starting readings. Expressions of oxygen uptakes, both/mg. nitrogen/hr. and/total epithelium/hr., are based on uptake for each entire hour rather than on initial rate.

Differences were tested statistically by the "U" test of Mann and Whitney (1947) using the hypothesis that there was no difference between groups and the alternative that there was a difference.

RESULTS

Effects of fasting.—(Table 1). There was no significant difference between fed and fasted rats in total nitrogen content of the small intestinal epithelium. Fortified epithelial homogenates from fed rats slightly exceeded those from fasted rats in endogenous oxygen uptake/mg. nitrogen; this difference probably has

TABLE 1

Nitrogen content and respiration rate of homogenates of small intestinal mucous epithelium from fed and fasted rats

Group	No. of rats	Total epithelial nitrogen, mg.	Oxygen uptake in first hour			
			μl./mg. nitrogen/hr.		ml./total epithelium/hr.	
			Endogenous	Increase with α-ketoglutarate	Endogenous	Increase with α-ketoglutarate
Total groups						
Fasted	7	71.8 (53.9–85.1)	51 (43–61)		3.6 (2.8–4.4)	
Fed	10	66.1 (53.6–94.1)	59 (43–65)*		3.9 (2.4–5.4)	
Subgroups†						
Fasted	6	74.7 (59.9–85.1)	51 (43–61)	9 (3–14)	3.8 (3.4–4.4)	0.7 (0.3–1.1)
Fed	6	70.0 (55.4–94.1)	59 (43–65)	30 (10–53)‡	4.1 (2.4–5.4)	2.1 (0.6–3.5)‡

Figures given are averages; ranges in parentheses.
Significant differences between comparable fed and fasted groups:
*0.05> P >0.02.
‡0.02> P >0.01.
†Subgroups made up of those rats in the total groups in which the effect of adding α-ketoglutarate was tested.

little physiological significance since the endogenous respiration of the *total* epithelium was the same in fed and fasted rats. In the presence of added α-ketoglutarate, respiration was increased in homogenates from both fed and fasted rats; however, the increase was about 3 times as great in the fed rats as in the fasted rats. Since this difference with α-ketoglutarate was significant statistically not only in oxygen uptake/mg. epithelial nitrogen but also in uptake/*total* epithelium, it appears to have a possible physiological significance.

Rates at 3 levels of small intestine.—(Table 2). There were no differences in endogenous oxidative rate/mg. nitrogen of fortified epithelial homogenates from the upper and middle thirds of small intestine. In the earlier work of Dickens and Weil-Malherbe (1941), the oxidative rate of mucosal strips was higher in jejunum than in duodenum; the division of the upper small gut differed from the division

in the present work; so the 2 studies are not directly comparable. The rate/mg. nitrogen with our homogenates from the lower third of the small intestine was significantly lower than with either the upper or middle thirds in the early hours of the test; this is consistent with work with strips of ileal mucosa in Ringer's solution or serum (Dickens and Weil-Malherbe, 1941). Table 2 shows also that oxidative rates/mg. nitrogen decreased from hour to hour in about the same way for upper and middle thirds, and a generally low level was reached by the fifth to seventh hour with these 2 segments from most of the rats. The rates with lower gut segments also decreased at first, but then they generally leveled off about the

TABLE 2

Endogenous respiration of homogenates of epithelium from upper, middle and lower thirds of the small intestine

	Upper	Middle	Lower
Total epithelial nitrogen, mg.	28.3 (23.8–34.1)	24.0 (21.6–26.4)*	21.1 (18.6–25.8)*
Oxygen uptake, μl./mg. nitrogen/hour for hours:			
1	62 (51–69)	59 (53–66)	35 (30–43)†‡
2	44 (38–48)	43 (38–50)	28 (26–31)†‡
3	32 (26–35)	32 (28–35)	21 (14–25)†§
4	21 (18–23)	24 (20–26)	18 (13–22)
5	10 (1–16)	15 (3–23)	15 (12–19)
6	6 (2–14)	12 (6–19)	14 (11–20)
7	4 (2– 9)	6 (2–11)	16 (9–20)*
Oxygen uptake of total segment epithelium, ml./hour, for hours:			
1	1.7 (1.4–2.3)	1.4 (1.3–1.5)	0.8 (0.6–1.1)†‡
2	1.2 (1.0–1.6)	1.0 (0.9–1.2)	0.6 (0.5–0.7)†‡

Figures are averages, with ranges in parentheses, for segments from 5 rats, except that only 4 rats are included in hours 3–7 for the middle third, 4–7 for the lower third, and 6–7 for the upper third; data from one of the 5 rats was omitted thus due to very rapid upturning of oxidative rate starting the third hour in the middle third and the fourth hour in the lower third.

*Significantly different from the upper third ($P<0.05$).
†Significantly different from the upper third ($P<0.01$).
‡Significantly different from the middle third ($P<0.01$).
§Significantly different from the middle third ($P<0.02$).

third to fifth hours, and sometimes turned up again about the fifth to seventh hours. This rate pattern in the lower third probably is due to the developing metabolism of microorganisms, as reported in occasional experiments with mucosa from lower ileum and colon (Dickens and Weil-Malherbe, 1941). The sharp rate upturns in middle and lower segments beginning in the third and fourth hours, respectively, in one of the rats must be due to a greater than usual microbial contamination. Thus, only the early, steadily declining respiration may safely be attributed to animal enzymes.

Table 2 shows also that the total nitrogen content of the entire epithelium obtained from the upper third was significantly greater than that of the middle or lower thirds. From the nitrogen content and the oxygen uptake mg. nitrogen, the total endogenous oxygen uptake for the entire epithelium from each segment

was calculated for the first 2 hours of the test (*i.e.*, for the period before bacterial metabolism began to interfere in any of the rats). These total uptakes for the lower segment were significantly lower than the corresponding values for both upper and middle segments in both the first and second hours (table 2). Also, the difference in total uptake between upper and middle thirds was very nearly significant statistically ($P = 0.056$) in the first hour.

DISCUSSION

The decreased ability of epithelium from fasted rats to oxidize added substrate (α-ketoglutarate) *in vitro* perhaps reflects a lesser ability to oxidize, *in vivo*, substrates derived from food, when oral feeding is begun again after a period of food deprivation. If so, rates of certain energy-dependent absorption processes in the intestine might decrease in fasted rats.

There are several possible explanations for the lower initial respiration rate in fasted rats' gut epithelium in the presence of added α-ketoglutarate. One is that in fasted rats there appear to be fewer respiring elements (mitochondria) in intestinal epithelial cells (Miller, 1922). Thus, a limiting level of respiratory catalysts perhaps prevented as great an increase with added substrate. However, the correctness of this explanation for our results is in doubt, since Miller's (1922) results were obtained with rats fasted for longer periods than used herein. Also, Miller's evidence is limited in value by difficulties of technique and by its inconsistency with earlier evidence. (See Macklin and Macklin, 1932, for a summary of the early work on effects of fasting on numbers of mitochondria.) Another possible explanation is suggested by the findings that prolonged underfeeding of rats from weaning resulted in a smaller oxygen consumption of small intestinal mucosa slices with glucose as substrate, and that this lesser repiration was due principally to protein restriction (Vitale *et al.*, 1953). However, the total epithelial nitrogen in our mature rats' small intestines was not decreased after 24 hours of feed deprivation, and so it is uncertain if total protein deficiency was involved in the smaller oxidation of α-ketoglutarate we observed in our fasted rats. Other explanations might be advanced, but there seems to be no evidence for or against any of them.

Evidence given herein that withdrawal of feed for 24 hours produced no detectable change in total nitrogen of rat small gut epithelium is consistent with histological evidence (Leblond and Stevens, 1948) that replacement of gut epithelium in rats continued during a 4-day fasting period. In contrast, fasting periods longer than 24 hours or more (depending on the season) in mice (Sun, 1927) or prolonged underfeeding from birth in rats (Miller, 1927) or underfeeding until death during an Indian famine in humans (Charlton, 1946) produced deterioration of intestinal epithelium. If the turnover time for the entire small gut epithelium is the same in fasted as in fed rats, *i.e.*, about 1½ days (Leblond and Stevens, 1948), then approximately ⅔ of the epithelium (containing about 48 mg. Kjeldahl nitrogen) must have been sloughed off and replaced during the 24-hour feed deprivation period employed herein. Nitrogen and amino acids used in this continuing replacement protein synthesis during the 24 hours without feed perhaps came partly from feed protein present in the gastrointestinal tract at the start of the fast, partly from digested protein of epithelial cells extruded into the lumen high up in the alimentary tract, and partly from rather readily labilized protein from other parts of the body.

The low oxygen consumption/mg. of nitrogen in epithelium from the lower small gut of fed rats could not be due to use in each flask of too little *total* tissue to sustain vigorous oxidation. (See Methods.) However, it could be due to use of too little oxidatively *active* tissue (mainly mitochondria) if, as seems possible, the ratio of mitochondria to total tissue is low in ileal epithelium.

SUMMARY

1. Respiration of fortified homogenates of the entire epithelium from the small gut was studied in rats from which feed had been withdrawn for 24 hours and in fed rats. Endogenous respiration rates differed little in fed and fasted rats; however, the increases in rates when α-ketoglutarate was added were strikingly higher in the fed rats. The nitrogen content of the total epithelium was the same in the fed and fasted rats.

2. The epithelial layers of the upper, middle, and lower thirds of the small gut were compared in fed rats. The upper third exceeded both the middle and lower thirds in total nitrogen content. Fortified homogenates from the upper and middle thirds each exceeded those from the lower third in endogenous oxygen uptake per mg. of nitrogen and in endogenous oxygen uptake per total segment epithelium, during early hours of the test. Later in the test period, other differences developed which were attributed to bacterial metabolism rather than to animal metabolism.

REFERENCES

Charlton, W. S. 1946. Blood transfusion in Indian famine. Lancet 250: 686–688.

Darlington, W. A. and **J. H. Quastel.** 1953. Absorption of sugars from isolated surviving intestine. Arch. Biochem. and Biophys. 43: 194–207.

Dickens, F. and **H. Weil-Malherbe.** 1941. Metabolism of normal and tumor tissue. XIX. The metabolism of intestinal mucous membrane. Biochem. Jour. 35: 7–15.

Hele, M. P. 1953. The phosphorylation and absorption of sugars in the rat. 1. Hexokinase activity in the intestinal mucosa. Biochem. Jour. 55: 857–863.

Leblond, C. P. and **C. E. Stevens.** 1948. Constant renewal of the intestinal epithelium in the albino rat. Anat. Record 100: 357–378.

Macklin, C. C. and **M. T. Macklin.** 1932. The intestinal epithelium. In: Cowdry, E. V., Special Cytology, 2nd ed., vol. 1. P. B. Hoeber, New York.

Mann, H. B. and **D. R. Whitney.** 1947. On a test of whether one of two random variables is stochastically larger than the other. Annals of Math. Statistics 18: 50–60.

Miller, S. P. 1922. Effects of various types of inanition upon the mitochondria in the gastrointestinal epithelium and in the pancreas of the albino rat. Anat. Record 23: 205–210.

———. 1927. Effects of inanition on the stomach and intestines of albino rats underfed from birth for various periods. Arch. Path. and Lab. Med. 3: 26–41.

Ponz, F. and **M. Lluch.** 1955. Coupling of cell metabolism and active transport in glucose absorption by the intestine. Revista Española de Fisiologia 11: 267–276.

Sun, T. P. 1927. Histophysiological study of the epithelial changes in the small intestine of the albino mouse after starvation and refeeding. Anat. Record 34: 341–349.

Vitale, J. J., D. M. Hegsted, J. DiGiorgio, and **N. Zamcheck.** 1953. Interrelations between panthothenic acid, protein and calorie intakes with respect to respiration and morphology of duodenal mucosa. Metabolism 2: 367–374.

The Ornithologists Guide. *H. P. W. Hutson*, Ed. Philosophical Library, Inc., New York. 1956. ix+275 pp. $10.00.

The Ornithologists Guide is a highly condensed review of many of the important aspects of present day bird study. The imposing list of forty six eminent English contributors is in itself a strong recommendation for the book. The major sections move concisely from the study of recognition, physical features and principles of nomenclature to discussions of geographical distribution, major behavior types, breeding relationships, and management. One of the most valuable areas involves study techniques of many kinds and suggestions for particular types of problems.

The considerable condensation required in a book of this type results in little that is new to the experienced ornithologist although the reading is enjoyable.

For those new in the field a thorough study of this book and the carefully selected references cited will save much time in the comprehension of the general subject.

L. S. Putnam

THE RELATIONSHIPS BETWEEN HERITABILITY AND TWIN EFFICIENCY VALUES CALCULATED FROM TWIN UNIFORMITY TRIALS[1]

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Since the inception of experimentation with monozygotic twins the terms "heritability" and "twin efficiency value" have been used widely. Heritability may be defined as the proportion of total variance in a population which is attributable to genetic differences between individuals. Twin efficiency value is defined as the number of pairs of unrelated animals in an experiment which one pair of monozygotic twins can replace without altering the statistical precision of the experiment (Bonnier, *et al.*, 1946). The formula for calculating heritability from twin data has been given by Thoele and Hervey (1952) while formulae for twin efficiency values have been presented by Dick and Whittle (1951) and Carter (1951). It is apparent that the more highly heritable a trait is the more efficient monozygotic twins will be in relation to unrelated animals in experiments involving this trait. Therefore, the two terms must be related in some way but a scrutiny of the literature reveals no presentation of this relationship. In this paper, the relationships between the formulae for heritability (Thoele and Hervey, 1952) and twin efficiency values (Carter, 1951; Dick and Whittle, 1951) will be derived.

TABLE 1

The analysis of variance of a twin uniformity trial

FACTOR	d.f.	MEAN SQUARE		COMPONENTS OF VARIANCE
Between pairs	n–1	M_B	=	$2\sigma^2_H+\sigma^2_E+\sigma^2_{HE}$
Within pairs	n	M_W	=	$\sigma^2_H+\sigma^2_{HE}$
Total	2n–1			
		M_B+M_W	=	$2(\sigma^2_H+\sigma^2_E+\sigma^2_{HE})$

The analysis of variance of a twin uniformity trial, according to Thoele and Hervey (1952), is shown in table 1, where $\mathbf{n}$ = the number of pairs of monozygotic twins, $\mathbf{M_B}$ = mean square (variance) between pairs, $\mathbf{M_W}$ = mean square (variance) within pairs, σ^2_H = variance due to heredity, σ^2_E = variance due to the environment

[1] Journal Article No. 45-55, The Ohio Agricultural Experiment Station. This publication is taken from a thesis submitted by the senior author to The Ohio State University in partial fulfillment of the requirements for the degree of Master of Science.

[2] The senior author wishes to acknowledge the tenure during part of this study of a postgraduate scholarship of the Department of Agriculture for Scotland. Present Address: Animal Husbandry Department, West of Scotland Agricultural College, Auchincruive, Ayr, Scotland.

and σ^2_{HE} = variance due to interaction between heredity and environment. It should be pointed out here that the analysis of variance table has been reproduced without change from the paper of Thoele and Hervey (1952). However, a slight correction is required as the interaction between heredity and environment would be found not in the within-pair mean square but would be found entirely in the between-pair mean square. This correction does not influence the results of the present paper.

Variance due to herdity

$$\sigma^2_H = \frac{\text{Mean square between pairs} - \text{Mean square within pairs}}{2} = \frac{M_B - M_W}{2}$$

$$\text{Heritability} = \frac{\sigma^2_H}{\sigma^2_H + \sigma^2_E + \sigma^2_{EH}}$$

$$= \frac{2\sigma^2_H}{2(\sigma^2_H + \sigma^2_E + \sigma^2_{HE})}$$

$$= \frac{M_B - M_W}{M_B + M_W}$$

The formulae are as follows:

Dick and Whittle (1951) $$E_1 = \frac{1}{2}\left(\frac{M_B}{M_W} - 1\right) \quad \ldots\ldots(1)$$

Carter (1951) $$E_2 = \frac{1}{2}\left(\frac{M_B}{M_W} + 1\right) \quad \ldots\ldots(2)$$

Thoele and Hervey (1952) $$H = \frac{M_B - M_W}{M_B + M_W} \quad \ldots\ldots(3)$$

where E = twin efficiency value, the subscript denoting which formula was used.
H = heritability.
M_B = mean square (variance) between pairs.
M_W = mean square (variance) within pairs.

Relationship of E_1 and E_2,

$$E_1 = \frac{1}{2}\left(\frac{M_B}{M_W} - 1\right) \quad \ldots\ldots(1)$$

$$\therefore \quad E_1 + 1 = \frac{1}{2}\left(\frac{M_B}{M_W}\right) - \frac{1}{2} + 1$$

$$\therefore \quad E_1 + 1 = \frac{1}{2}\left(\frac{M_B}{M_W}\right) + \frac{1}{2}$$

$$\therefore \quad E_1 + 1 = \frac{1}{2}\left(\frac{M_B}{M_W} + 1\right) = E_2$$

$$E_1 + 1 = E_2, \text{ or } E_1 = E_2 - 1 \quad \ldots\ldots(4)$$

Relationship between H and E_1 and E_2,

$$E_1 = \frac{1}{2}\left(\frac{M_B}{M_W} - 1\right) \quad \ldots\ldots (1)$$

$$\therefore \quad E_1 = \frac{1}{2}\left(\frac{M_B - M_W}{M_W}\right)$$

$$\therefore \quad E_1 = \frac{M_B - M_W}{2M_W}$$

$$\therefore \quad M_B - M_W = 2M_W \cdot E_1$$

Substituting, $2M_W \cdot E_1$ for $M_B - M_W$ in equation (3).

$$H = \frac{2M_W \cdot E_1}{M_B + M_W}$$

Rearranging,

$$\frac{E_1}{H} = \frac{M_B + M_W}{2M_W}$$

$$\therefore \quad \frac{E_1}{H} = \frac{1}{2}\left(\frac{M_B + M_W}{M_W}\right)$$

$$\therefore \quad \frac{E_1}{H} = \frac{1}{2}\left(\frac{M_B}{M_W} + 1\right)$$

$$\therefore \quad \frac{E_1}{H} = E_2 \quad \ldots\ldots \text{from equation (2)}$$

$$\therefore \quad \frac{E_1}{H} = E_1 + 1 \quad \ldots\ldots \text{from equation (4)}$$

$$\therefore \quad H = \frac{E_1}{E_1 + 1} \quad \ldots\ldots (5)$$

$$\text{and} \quad H = \frac{E_2 - 1}{E_2} \quad \ldots\ldots (6)$$

The solution of equations (5) and (6) for E gives

$$E_1 = \frac{H}{1 - H} \quad \ldots\ldots (7)$$

$$\text{and} \quad E_2 = \frac{1}{1 - H} \quad \ldots\ldots (8)$$

Summarizing,

$$E_1 = E_2 - 1 \text{ and } E_2 = E_1 + 1 \quad \ldots\ldots(4)$$

$$H = \frac{E_1}{E_1 + 1} \quad \ldots\ldots(5)$$

$$^3H = \frac{E_2 - 1}{E_2} \quad \ldots\ldots(6)$$

[3]This formula was in error in the abstract in Jour. Dairy Sci. 38(6): 616. 1955.

$$E_1 = \frac{H}{1 - H} \quad \ldots\ldots(7)$$

$$E_2 = \frac{1}{1 - H} \quad \ldots\ldots(8)$$

Figure 1 shows the relationship between Carter's efficiency value and heritability. Carter's formula (1951) was selected in preference to that of Dick and Whittle (1951) because the former gives a value of one if heritability is zero, whereas the latter formula gives a value of zero. A value of one should be expected as a pair of monozygotic twins would be as useful as a pair of unrelated animals when heritability was zero, provided maternal effects were negligible.

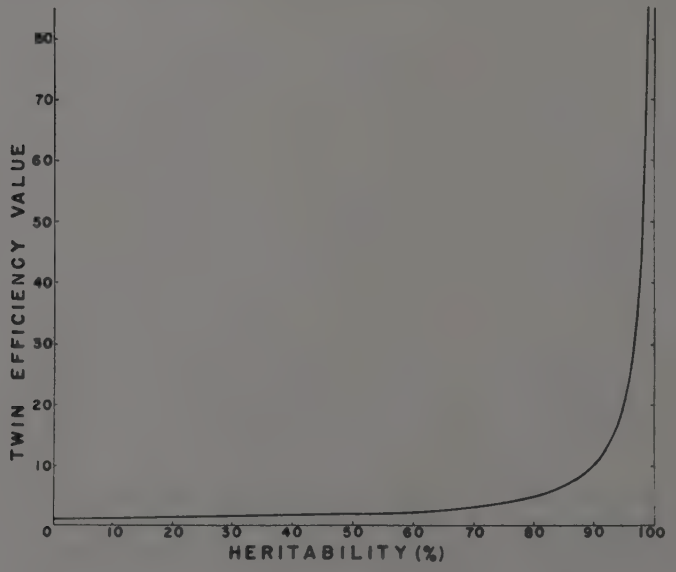

FIGURE 1
Chart showing relationship between heritability and twin efficiency value of Carter (1951).

It will be seen that the efficiency changes but little (1 to 10) over the range 0 to 90 percent heritability while at heritabilities higher than 95 percent the change in efficiency is great per percentage unit of heritability. As heritability approaches 100 percent the efficiency value approaches infinity. Figure 1 could be enlarged if it were desired to find efficiency values graphically from heritability estimates.

SUMMARY

The relationships between the heritability and twin efficiency values in twin uniformity trials have been derived.

It has been shown that the twin efficiency value changes slowly with changes in heritability below 70 or 80 percent and thereafter much more rapidly, especially at heritabilities of 95 percent and above.

REFERENCES

Bonnier, G., A. Hansson, and **T. Düring.** 1946. Tvillingmetodens Effektivitet. (The efficiency of the twin method.) Kungl. Lantbruksakademiens Tidskrift. 85: 455.

Carter, A. H. 1951. Paper presented at the 7th New Zealand Science Congress. Cited in Hancock.

Dick, I. D. and **P. Whittle.** 1951. Contributions to the statistical design of identical twin experiments. New Zealand Jour. Sci. Technol. B33(3): 145.

Hancock, J. 1954. Monozygotic twins in cattle. Adv. Genetics 6: 141. Academic Press, New York.

Thoele, H. W. and **M. C. Hervey.** 1952. Growth uniformity trials with identical twin dairy heifers—estimates of heritability and twin efficiency. Jour. Dairy Sci. 35: 494. Paper presented at Forty-Seventh Annual Meeting Amer. Dairy Sci. Assoc.

Handbook of Snakes of the United States and Canada. *Albert Hazen Wright* and *Anna Allen Wright.* Comstock Publishing Associates, Ithaca, New York. 1957. 2 Vol. xviii+ 1105 pp. $14.75.

The authors have endeavored to bring up to date in three volumes the mass of accumulated information on the snakes of the United States and Canada. Thus far the first two volumes are complete. The third volume, planned as a bibliography of snakes, should make this series a classic in this field as the author's *Handbook of Frogs and Toads of the United States and Canada* has become a classic in its field.

These two volumes contain a table of contents; an introduction; keys to families, genera, species, and subspecies; accounts of species; an illustrated glossary; a list of North American references; and an index. The keys are accompanied by excellent illustrations which should help anyone using them, especially the inexperienced person. Although the keys are excellent, the reviewer feels that page numbers added to the key would have facilitated its use. In addition to the illustrated key, hundreds of individual photographs have been used to make up composite photographs showing the distinctive characteristics of many of the species. In the discussion of each species information has been arranged as far as possible in the following manner: Name of species, range (including distribution maps), size of adults, longevity, distinctive characteristics, color, habitat, period of activity, breeding, ecdysis, food, venom, enemies, field notes, and authorities.

The style of writing is clear and easy to read. The printing and illustrations are excellent. In the reviewer's opinion this *Handbook of Snakes* will be highly appreciated by both the specialist and the amateur naturalist.

N. Wilson Britt

A NEW *AGRILUS* FROM THE CHIRICAHUA MOUNTAINS OF ARIZONA

(COLEOPTERA: BUPRESTIDAE)

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The following *Agrilus* was among material sent for identification.

Agrilus howdeni n. sp.

Male.—Size and form of *A. celti* Knull, shining greenish bronze throughout, front opaque green.

Head convex, without median depression; surface on front granulose, with well separated light punctures, vertex strigose; antennae short, not reaching to middle of pronotum when laid along side, serrate from fifth segment.

Male genitalia of *Agrilus howdeni* n. sp. **1.** dorsal view; **2.** ventral view.

Pronotum convex, wider than long, widest in front of middle, narrower at base than at apex; sides converging from back of apex toward base, then expanded at base; when viewed from side, marginal and submarginal carinae separated and joined at base; anterior margin sinuate, median lobe broadly rounded; base strongly sinuate, median lobe emarginate; disk convex, slight indication of median depression, a strong lateral depression each side, prehumeral carinae well developed; surface transversely rugose, punctate between rugae. Scutellum transversely carinate, surface reticulate.

Elytra at base wider than base of pronotum; sides subparallel near base, constricted back of middle, then broadly rounded to rounded serrulate apices; disk with sutural margin elevated posteriorly, each elytron with a strong basal depression and a shallow elongate depression on

basal half; surface imbricate-punctate, sparsely clothed with short inconspicuous white hairs, median depression and a rounded area on apical third near suture with longer pubescence.

Abdomen beneath densely, finely punctate, recumbent pubescence short; first and second segments slightly concave. Prosternum clothed with longer white pubescence, which extends along ventral surface to third abdominal segment; prosternal lobe broadly rounded, prosternal process expanded back of coxal cavities. Posterior coxae emarginate along margin, exterior angle acute. Tibiae slender, anterior and middle pairs armed with a tooth on inside at apices. Tarsal claws similar on all feet, cleft near middle, outer tooth acute, inner tooth broad, much shorter, claws not turned inward.

Length 3.6 mm.; width .9 mm.

Female.—First two ventral segments convex at middle, median line of pubescence lacking; tibiae unarmed at apices.

Holotype ♂, allotype and one ♀ paratype collected from sycamore (*Platanus wrightii* Wats.) at Southwestern Research Station of American Museum of Natural History, Portal, Arizona, June 10, 1956 by H. and A. Howden.

Holotype in collection of author, allotype and paratype in collection of H. F. Howden. I take pleasure in naming this insect for Dr. Howden.

According to Fisher (1928) this species runs to *A. abductus* Horn. The smaller size, color, convex pronotum and type of pubescence on elytra will distinguish it. The genitalia are also different.

REFERENCE

Fisher, W. S. 1928. A revision of the North American species of buprestid beetles belonging to the genus Agrilus. U. S. Nat. Mus. Bull. 145: 1–347.

Dairy Microbiology. *Edwin M. Foster, F. Eugene Nelson, Marvin L. Speck, Raymond N. Doetsch,* and *Joseph C. Olson, Jr.* Prentice-Hall, Englewood Cliffs, N. J. 1957. 492 pp. $7.50.

The several authors are to be congratulated for this much-needed, modern text in which the competency of the authors is reflected in the product. By intent the text is quite complete and practical; in the latter it conforms with the status of dairy microbiology as an intensely practical subdivision of microbiology. The first third of the text deals generally with microorganisms associated with dairy products and their properties; the remainder considers in detail microbiology (one might say technology) of various dairy products from acidophilus milk to Yogurt, including a pertinent chapter on waste disposal and utilization of by-products of the dairy plant. The book is well-fortified but not loaded with illustrations and references. This work can provide real meat for dairy bacteriology courses requiring sound preparation in general bacteriology.

CHESTER I. RANDLES

Here is Haiti. *Ruth Danenhower Wilson.* Philosophical Library, New York. 1957. 204 pp. $3.50.

The recent social turmoil at Haiti becomes more comprehensible with the background supplied by this white American sociologist. Miss Wilson's sojourn in Haiti followed her study of Negroes in the armed forces of the United States, and her stay there enabled her to see social problems in a population in which there are almost no pure white people. She was able, fortunately, to visit much of the area occupied by the Republic, and her critical comments about the problems of matching economic well-being with hopeless over population, are pertinent indeed.

The discussion of island social customs, of Voodoo, Virgins, Wives and Placées (unwed wives), of the results of 19 years of occupation by the U. S. Marines (in bitterness, disorganization, fear of schools, and in half-breed bastards), and of the prospects of improved economy as partial result of U. S aid in constructing dams and improving land-use practices, brings startling realization that our national pride need not cover all aspects of our relations with other nations.

THOMAS H. LANGLOIS

THE PARASITIC FUNGI OF OHIO PLANTS[1]

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Several thousand species of fungi, about 170 species of bacteria, many viruses, nematodes, and other agents cause disease in plants. Recent estimates by the United Stated Department of Agriculture (1954) indicate that the annual loss in the United States attributed to these diseases is around three billion dollars. In Ohio the annual loss due to plant diseases, based on 1950 prices, is estimated to be 100,000,000 dollars.

There are many examples of diseases which are or have been the limiting factor in the successful production of a crop in one or more areas of Ohio. A few examples include potato late blight, tomato late blight, barley powdery mildew, corn leaf blight, sweet corn bacterial wilt, peach and plum brown rot, cherry leaf spot, grape black rot, fire blight of pear, apple scab, sugar beet leaf spot, rose black spot cucurbit bacterial wilt, alfalfa bacterial wilt, soybean root rot, Helminthosporium blight of oats, and clover anthracnose. Flax culture in Ohio was eliminated in the 1800's largely because of the seriousness of fusarium wilt and the cultivation of pears in the state is seldom profitable because of the fire blight disease. Virus diseases are the most important factors to be considered in raspberry culture in Ohio.

The plant pathologist has a need for more exact information regarding the distribution of the parasitic fungi. Such information would enable him to identify plant diseases more readily and to plan research projects and control programs. Plant science as a whole, is certain to profit from a more precise knowledge of the geographical distribution, ecology, and habitats of the fungi.

HISTORICAL SUMMARY

The first list of the fungus flora of Ohio was published in 1849 as a part of a *Catalogue of Plants, Native and Naturalized, Collected in the Vicinity of Cincinnati, Ohio, During the Years 1834-1844.* This catalogue was prepared by Thomas G. Lea (1849) and included 1,050 plants of which 319 were fungi. Twenty to thirty of these would today be considered plant pathogens; however, at the time, fungi were not generally recognized as causing plant disease. In 1878, A. P. Morgan's *Flora of the Miami Valley* was published and included a list of fungi but no parasitic species (Morgan, 1878).

Beginning in the late 1880's several persons were active as collectors of parasitic fungi and in some instances, studied fungi as incitants of disease. In 1889 Frederica Detmers was appointed Assistant Botanist at the Ohio Agricultural Experiment Station in Columbus and during the next few years she reported on many diseases of fruit and vegetable crops, and prepared two lists of the rust fungi of Ohio (Detmers, 1892, 1893). In 1894, A. D. Selby became Botanist at the Ohio Agricultural Experiment Station, now at Wooster, and contributed greatly to our knowledge of plant pathology. Even before his appointment to the Station staff, Selby (1893) had prepared a list of Ohio Erysiphaceae. One of his more important publications, and one of the first of its kind in the United States was a handbook of plant diseases prepared in 1900 and revised in 1910 (Selby, 1900, 1910).

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[1]Publication 599, Department of Botany and Plant Pathology, The Ohio State University.

W. A. Kellerman was elected Chairman of the newly organized Department of Botany and Forestry at The Ohio State University in 1891. From then until his death in 1908, he collected extensively, adding many specimens of parasitic fungi to the herbarium at the University. Kellerman and Werner (1893) prepared the Botany section of Volume 7 of the *Report of the Geological Survey of Ohio* which included a complete list of the known Ohio fungi with 1000 species listed of which about 250 are parasitic. From 1901 to 1905 Kellerman published and issued the *Ohio Fungi Exsiccati*. This was issued in ten fasicles and included descriptions of 200 species of fungi, most of which are plant parasites.

Edo Claassen collected plants in Cuyahoga and nearby counties of northern Ohio from 1895 to the early 1920's. In the 1890's Claassen (1896a, 1896b, 1897a, 1897b, 1899a, 1899b) published four lists of powdery mildew fungi and two lists of Uredinales of the area.

F. L. Stevens (1896a, 1896b, 1897, 1898), an instructor at North High School in Columbus from 1894 to 1898, collected in central Ohio and prepared four lists of parasitic fungi.

Other collectors of Ohio parasitic fungi during this early period include W. H. Aiken, Cincinnati, E. E. Bogue, Ashtabula County, Thomas Bonser, Wyandot County, Moses Craig, C. M. Weed, L. C. Riddle and E. M. Wilcox, Columbus, and F. D. Kelsey of Oberlin and Toledo. Many of their collections are in herbaria at The Ohio State University, the Ohio Agricultural Experiment Station, Oberlin College, and the University of Cincinnati.

O'Kane (1910) prepared a paper on the powdery mildew fungi of Ohio with a list of the species and their host's as known at that time. Brain (1912) published a list of fungi from the vicinity of Cedar Point which included about 100 plant pathogens.

Since 1910 there have been many publications pertaining to plant diseases in Ohio and many additions to the herbaria of plant parasitic fungi. Most of these reports and collections have been by plant pathologists associated with the Department of Botany and Plant Pathology at the Ohio Experiment Station or The Ohio State University. However, not since the report of Kellerman and Werner (1893) has there been a comprehensive list of the Ohio fungi parasitic on plants.

SOURCES OF DATA

A list of the known parasitic fungi of Ohio plants has been prepared from: (1) herbarium collections, (2) published records, and (3) collections and observations of the author.

The collections in the herbaria at The Ohio State University, the Ohio Agricultural Experiment Station, and Oberlin College were studied. The fungi in the herbarium of the University of Cincinnati have been studied and enumerated by Cooke (1941, 1943).

Since 1940, the author has collected and identified, or observed and identified parasitic fungi from all counties in Ohio.

THE GENERA OF PARASITIC FUNGI IN OHIO

In the list which follows the arrangement of the fungus genera is alphabetical under the order to which they are referred. The arrangement of the orders within the classes of fungi and the placement of the genera in the orders, with but few exceptions, follows Ainsworth and Bisby (1950). As some bacteria are important plant parasites they are included and the genera of bacteria are those recognized by Elliott (1951). The number of Ohio species in each genus is indicated.

SCHIZOMYCETES
- Eubacteriales
  - *Agrobacterium* (2)
  - *Bacterium* (1)
  - *Corynebacterium* (5)
  - *Erwinia* (6)
  - *Pseudomonas* (24)
  - *Xanthomonas* (10)
- Actinomycetales
  - *Streptomyces* (1)

PHYCOMYCETES
- Chytridiales
  - *Physoderma* (1)
  - *Synchytrium* (2)
- Plasmodiophorales
  - *Plasmodiophora* (1)
  - *Spongospora* (1)
- Saprolegniales
  - *Aphanomyces* (2)
- Peronosporales
  - *Albugo* (*Cystopus*) (5)
  - *Bremia* (1)
  - *Peronospora* (18)
  - *Phytophthora* (7)
  - *Plasmopara* (5)
  - *Pseudoperonospora* (1)
  - *Pythiogeton* (1)
  - *Pythium* (5)
  - *Sclerospora* (1)
- Mucorales
  - *Choanephora* (1)
  - *Mucor* (1)
  - *Rhizopus* (1)
  - *Spinellus* (1)
  - *Sporodinia* (*Syzygites*) (1)

ASCOMYCETES
- Taphrinales
  - *Taphrina* (8)
- Myriangiales
  - *Elsinoe* (2)
- Dothideales
  - *Cymadothea* (1)
  - *Dibotryon* (1)
  - *Endothella* (1)
  - *Phyllachora* (5)
  - *Scorias* (1)
- Hemisphaeriales
  - *Asterina* (1)
- Erysiphales
  - *Apiosporina* (1)
  - *Erysiphe* (5)
  - *Microsphaera* (5)
  - *Phyllactinia* (2)
  - *Podosphaera* (3)
  - *Sphaerotheca* (4)
  - *Uncinula* (8)
- Hypocreales
  - *Balansia* (2)
  - *Claviceps* (2)
  - *Cordyceps* (2)
  - *Epichloe* (1)
  - *Gibberella* (2)
  - *Hypocrea* (1)
  - *Hypocreopsis* (1)
  - *Hypomyces* (3)
  - *Nectria* (2)
  - *Pseudonectria* (1)
  - *Thyronectria* (1)
- Sphaeriales
  - *Botryosphaeria* (1)
  - *Ceratostomella* (1)
  - *Cochliobolus* (1)
  - *Cryptodiaporthe* (1)
  - *Cryptosporella* (2)
  - *Diaporthe* (4)
  - *Didymella* (1)
  - *Didymellina* (1)
  - *Endoconidiophora* (2)
  - *Endothia* (1)
  - *Glomerella* (2)
  - *Gnomonia* (5)
  - *Gnomoniella* (1)
  - *Guignardia* (3)
  - *Leptosphaeria* (2)
  - *Linospora* (1)
  - *Mycosphaerella* (18)
  - *Nummularia* (1)
  - *Ophiobolus* (1)
  - *Physalospora* (1)
  - *Pleospora* (1)
  - *Pyrenophora* (3)
  - *Rosellinia* (1)
  - *Sphaerulina* (1)
  - *Ustulina* (1)
  - *Valsa* (2)
  - *Venturia* (3)
  - *Xylaria* (1)
- Phacidiales
  - *Coccomyces* (3)
  - *Elytroderma* (1)
  - *Hypoderma* (2)
  - *Hypodermella* (1)
  - *Lophodermium* (1)
  - *Rhytisma* (5)
- Helotiales
  - *Atropellis* (1)
  - *Cenangium* (1)
  - *Dasyscypha* (1)

Diplocarpon (2)
Fabraea (2)
Monilinia (1)
Pezizella (1)
Pseudopeziza (3)
Pyrenopeziza (1)
Roesleria (1)
Sclerotinia (4)
Seaverinia (1)
Septotinia (1)
Stamnaria (1)
Stromatinia (1)
Tympanis (1)

BASIDIOMYCETES

Ustilaginales
Cintractia (1)
Doassansia (1)
Entyloma (7)
Graphiola (1)
Melanopsichium (1)
Schizonella (1)
Sorosporium (3)
Sphacelotheca (5)
Tilletia (5)
Urocystis (6)
Ustilago (16)

Uredinales
Aecidium (1)
Cerotelium (1)
Chrysomyxa (1)
Coleosporium (9)
Cronartium (4)
Frommea (1)
Gymnoconia (1)
Gymnosporangium (6)
Hyalopsora (1)
Kuehneola (1)
Kunkelia (1)
Melampsora (4)
Phragmidium (5)
Pileolaria (1)
Puccinia (72)
Pucciniastrum (7)
Ravenelia (2)
Tranzschelia (3)
Uredinopsis (1)
Uromyces (27)

Tremellales
Eocronartium (1)
Herpobasidium (1)

Agaricales
Armillaria (1)
Boletus (1)
Collybia (1)
Cyphella (1)
Exobasidium (1)
Fomes (7)
Ganoderma (1)
Hericium (1)
Pellicularia (1)
Pholiota (1)
Pleurotus (1)
Polyporus (11)
Steccherinum (1)
Stereum (3)
Thelephora (1)

FUNGI IMPERFECTI

Sphaeropsidales
Actinopelte (1)
Amerosporium (1)
Ascochyta (13)
Botryodiplodia (1)
Cicinnobolus (1)
Coniothyrium (6)
Cytospora (3)
Darluca (1)
Dendrophoma (1)
Diplodia (4)
Dothichiza (1)
Dothiorella (2)
Dothistroma (1)
Fusicoccum (1)
Gloeodes (1)
Leptothyrium (1)
Macrophoma (2)
Macrophomina (1)
Phleospora (5)
Phoma (9)
Phomopsis (9)
Phyllosticta (48)
Piggotia (1)
Plenodomus (1)
Pyrenochaeta (1)
Septoria (95)
Sphaeropsis (5)
Sporonema (2)
Stagonospora (5)

Melanconiales
Actinonema (1)
Colletotrichum (13)
Coryneum (2)
Cylindrosporium (8)
Entomosporium (1)
Gloeosporium (18)
Marssonina (10)
Melanconium (1)
Monochaetia (1)
Myxosporium (1)

Pestalotia (5)
Septogloeum (1)
Septomyxa (1)
Sphaceloma (4)
Moniliales
Alternaria (12)
Aspergillus (1)
Botrytis (7)
Cephalosporium (2)
Cercospora (82)
Cercosporella (4)
Chalara (1)
Cladosporium (5)
Curvularia (1)
Cylindrocladium (1)
Didymaria (1)
Epicoccum (1)
Fusarium (8)
Fusicladium (5)
Graphium (2)
Helminthosporium (13)
Heterosporium (2)
Kabatiella (2)
Microstroma (1)
Monilochaetes (1)
Myceliophthora (1)
Myrothecium (1)
Nigrospora (1)
Oidium (1)
Ovularia (1)
Penicillium (2)
Piricularia (1)
Polythrincium (1)
Pseudocercospora (1)
Ramularia (23)
Rhynchosporium (1)
Scolecotrichum (1)
Sepedonium (1)
Septocylindrium (1)
Spondylocladium (1)
Stemphylium (3)
Stigmina (1)
Thielaviopsis (1)
Trichoderma (1)
Trichothecium (1)
Tuberculina (1)
Verticillium (1)
Volutella (1)
Mycelia Sterilia
Papulospora (1)
Rhizoctonia (3)
Sclerotium (2)

DISCUSSION AND SUMMARY

The complete list of parasitic species and their host plants, too extensive to include here, will be published elsewhere. A summary of the study discloses 985 species and varieties of parasitic fungi and bacteria on Ohio plants with over 2100 combinations of host and parasite. Included among the parasites in Ohio are 49 bacterial species, 44 species of downy mildew fungi, 27 of powdery mildew fungi, 47 species of smut fungi, 150 of rust fungi, 48 species of *Phyllosticta*, 82 species of *Cercospora* and 95 species of *Septoria*. The fungus with the largest number of suscepts is *Erysiphe cichoracearum* DC. ex Merat with 51. The host with the largest number of pathogens is *Pyrus malus* L. with 30. Forty three species of fungi are reported in Ohio for the first time and 72 pathogens are reported for the first time on a particular host.

The number of known species of fungi is reported from 34,000 to more than 100,000 and the basis for most of these estimates is the approximately 80,000 entries in the compilation by Saccardo (1882–1931). The estimates vary depending upon the author's concept of a species and according to their estimate of the number of synonyms in Saccardo and their estimate of the number of species described since the last volume of Saccardo. In most text-books on botany the number of known species of Spermatophyta is given from 160,000 to 225,000. Bisby (1933), and Martin (1951) believe that when the fungus flora is well known the number of fungus species will equal or exceed the number of species of seed plants. In many smaller geographical areas there are now known 2 to 3 times as many fungus species as seed plants. In Manitoba, Bisby, Buller and Dearness (1929) report about twice as many fungi as seed plants. Lind (1913) reports 3324 species of fungi from Denmark compared with 1400 Spermatophytes. Bisby and Ainsworth (1943) estimate 6000 valid species of fungi in Britain while 2362 Spermatophytes and Pteridophytes are known.

In Ohio the vascular flora is well known and approximately 2500 native and naturalized vascular plants have been enumerated. There is no comprehensive, recent list of the Ohio fungi, saprophytic and parasitic, but it is estimated that there are at least 2400 reported species and that this represents not more than 50 per cent of the fungus flora of the area.

Parasitic fungi may be present in an area for many years causing little loss. Then, when new varieties (genotypes) of crop plants are introduced or when the cultivation of the crop is intensified or when cropping sequences are altered, these parasitic fungi may become the limiting factors to successful cultivation of that crop. *Helminthosporium turcicum* Pass., a leaf parasite of corn, was reported in Ohio by Selby (1900) and from then until 1939 it was seldom mentioned in reports or discussions of corn pathology in Ohio. In 1939 *H. turcicum* was reported as a major pathogen of certain corn hybrids and the factor limiting their cultivation in parts of Ohio (Ellett, 1943). It is important that plant pathologists, geneticists, agronomists, and horticulturists working together in the development and introduction of new crops and crop varieties be cognizant of the pathogens, minor or major, of these crops.

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REFERENCES

Ainsworth, G. C. and **G. R. Bisby.** 1950. A dictionary of the fungi. 3rd ed. Commonwealth Mycol. Inst., Kew, Surrey, England. 447 pp.

Bisby, G. R. 1933. The distribution of fungi as compared with that of phanerogams. Amer. Jour. Bot. 20: 246–254.

Bisby, G. R. and **G. C. Ainsworth.** 1943. The numbers of fungi. Brit. Mycol. Soc. Trans. 26: 16–19.

Bisby, G. R., A. H. R. Buller, and **J. Dearness.** 1929. The fungi of Manitoba. Longmans, Green and Co., London. 194 pp.

Brain, C. K. 1912. A list of the fungi of Cedar Point. Ohio Nat. 13: 25–36.

Claassen, E. 1896a. List of the "White Mildews" (Erysipheae, Lev.) of Cuyahoga County and of their host plants. Ann. Rpt. Ohio Acad. Sci. 4: 31–32.

———. 1896b. List of "White Mildews" (Erysipheae, Lev.), either not found in Cuyahoga County, or not on the below named host plants, but collected in Erie (a), or Medina (b) County. Ann. Rpt. Ohio Acad. Sci. 4: 32.

———. 1897a. Second list of Erysipheae, Lev. (White Mildews) of Cuyahoga and other counties of northern Ohio, together with the names of their host-plants. Ann. Rpt. Ohio Acad. Sci. 5: 67.

———. 1897b. List of the Uredineae of Cuyahoga and other counties of northern Ohio, together with the names of their host-plants. Ann. Rpt. Ohio Acad. Sci. 5: 68–69.

———. 1899a. Third list of the Erysipheae, Lev. (White Mildews) of Cuyahoga and other counties of northern Ohio, together with the names of their host-plants. Ann. Rept. Ohio Acad. Sci. 7: 42–43.

———. 1899b. Second list of the Uredineae of Cuyahoga and other counties of northern Ohio, together with the names of their host-plants. Ann. Rpt. Ohio Acad. Sci. 7: 43–44.

Cooke, W. B. 1941. Some parasitic and saprobic fungi of southern Ohio. U. S. Dept. Agr. Pl. Dis. Rptr. 25: 190–200.

———. 1943. Some parasitic and saprobic fungi of southern Ohio—II, III. U. S. Dept. Agr. Pl. Dis. Rptr. 27: 24–35.

Detmers, Frederica. 1892. A preliminary list of the rusts of Ohio. Ohio Agr. Exp. Sta. Bul. 44 (Vol. 5, No. 7): 133–140.

———. 1893. Additions to the preliminary list of the Uredineae of Ohio. Ohio Agr. Exp. Sta. Tech. Ser. Vol. 1, No. 3, Art. 14: 171–180.

Ellett, C. W. 1943. Leaf blight of corn. Phytopath. 33: 407–408.

Elliott, Charlotte. 1951. Manual of bacterial plant pathogens. Rev. ed. Chronica Botanica Co., Waltham, Mass. 186 pp.

Kellerman, W. A. 1901. Ohio fungi exsiccati. Fascicles I–II. Ohio Nat. 2: 135–140, 205–213.

———. 1902. Ohio fungi exsiccati. Fascicles III–V. Jour. Mycol. 8: 5–11, 56–62, 119–125.

———. 1903. Ohio fungi exsiccati. Fascicles VI–VIII. Jour. Mycol. 9: 17–24, 110–116, 171–176.
———. 1904. Ohio fungi exsiccati. Fascicle IX. Jour. Mycol. 10: 55–62.
———. 1905. Ohio fungi exsiccati. Fascicle X. Jour. Mycol. 11: 38–45.
——— and **W. C. Werner.** 1893. Catalogue of Ohio plants. Rpt. Ohio Geol. Survey 7: 56–406.
Lea, T. G. 1849. Catalogue of plants, native and naturalized, collected in the vicinity of Cincinnati, Ohio during years 1834–1844. Philadelphia. 77 pp.
Lind, J. 1913. Danish fungi as reported in the herbarium of E. Rostrup. Gyldendalske Boghandel-Nordisk Forlag, Copenhagen. 648 pp.
Martin, G. W. 1951. The numbers of fungi. Proc. Iowa Acad. Sci. 58: 175–178.
Morgan, A. P. 1878. Flora of the Miami Valley. Literary Union, Dayton, Ohio. 68 pp.
O'Kane, W. C. 1910. The Ohio powdery mildews. Ohio Nat. 10: 166–176.
Saccardo, P. A. 1882–1931. Sylloge fungorum. 1–25. Pavia, Italy.
Selby, A. D. 1893. The Ohio Erysipheae. Ohio Agr. Exp. Sta. Tech. Ser. Vol. 1, No. 3, Art. 18: 213–224.
———. 1900. A condensed handbook of the diseases of cultivated plants in Ohio. Ohio Agr. Exp. Sta. Bul. 121.
———. 1910. A brief handbook of the diseases of cultivated plants in Ohio. Ohio Agr. Exp. Sta. Bul. 214.
Stevens, F. L. 1896a. Parasitic fungi on Ohio weeds. Jour. Columbus Hort. Soc. 11: 120–126.
———. 1896b. Ohio parasitic fungi. Ann. Rpt. Ohio Acad. Sci. 4: 18–23.
———. 1897. Additions to Ohio fungi. Ann. Rpt. Ohio Acad. Sci. 5: 63–66.
———. 1898. Fungi new to Ohio. Ann. Rpt. Ohio Acad. Sci. 6: 37–38.
United States Dept. Agr., Agr. Res. Service. 1954. Losses in agriculture. U. S. Govt. Ptg. Off., Washington. 190 pp.

The Oscilloscope at Work. *A. Haas* and *R. W. Hallows.* Philosophical Library, New York. 1956. 171 pp., 102 diagrams, 217 oscillograms. $10.00.

This book is an adaptation and enlargement of the original French work "L'Oscillographe au Travail" by A. Haas. The text forms an intimate commentary on the state of the art of electronics and on the frugality in instrumentation which exist in Europe. However, in American usage, experimentalists would more conveniently employ other instruments for tasks which the author gives to the oscilloscope. Ingenuity in circuit design is evident and the reader may count on adding to his store of tricks. Among the topics treated are the investigation of electrical magnitudes, various oscillators and amplifiers, modulation and a good elementary treatment of phase shifting and pulse shaping circuits. A quotation, ". . . there is no need for us to plunge into the integral calculus" illustrates the non-mathematical character of subject treatment. The relatively high cost is accounted for by the lavish and sometimes redundant use of oscillograms.

RICHARD W. STOW

Precision Electrical Measurements. *The National Physical Laboratory* (Great Britain), Eds. Philosophical Library, New York. 1956. xxii+370 pp. $12.00.

This volume consists of the twenty six papers presented at an international symposium on Precision Electrical Measurements which was held at the National Physical Laboratory in November 1954. The papers are about equally divided among five broad categories: Capacitance and Dielectrics, Inductance and Magnetics, Electrotechnics, High Voltage Measurements and High Voltage Impulse Testing Techniques.

In common with most symposia the details of the contributions at this meeting are not of general interest. Though the caliber of the work presented is unquestionably high, the average reader will not delve deeply into such topics as: A precision Dual Admittance Bridge for the Range 3 Mc/s to 300 Mc/s; and the Stabilization of A.C. Power Supplies derived from Rotating Machinery. This collection of essays belongs in the university library and the person who uses electrical laboratory equipment will gain insight and breadth of understanding from a persual of some of the contributions presented here. One such paper is the article by Chester Peterson of our own National Bureau of Standards on the history of the development of alloys for precision resistors.

RICHARD W. STOW

ANNUAL REPORT OF THE OHIO ACADEMY OF SCIENCE
1957

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REPORT OF THE SIXTY-SIXTH ANNUAL MEETING OF THE OHIO ACADEMY OF SCIENCE

The 66th annual meeting was held on the campus of Bowling Green State University at Bowling Green during April 18 to 20, 1957. It was the first Academy meeting to be held at that institution. A total of 494 registered for the meetings of the Senior Division. Dr. John R. Coash and his local committee made the arrangements for meetings, field trips, housing, and dining facilities. The Executive Committee and the Council held meetings on April 18 for the transaction of business.

On Friday, April 19, ten sections and one subsection held meetings in the following fields: Zoology, Plant Sciences, Genetics, Geology, Medical Sciences, Physics and Astronomy, Geography, Chemistry, Science Education, Anthropology and Sociology, and Conservation. More than 100 research papers were presented and discussed. A special feature entitled "Explosions in Hospitals: a Live Demonstration" was presented by Dr. George J. Thomas under the auspices of the Medical Science Section. Symposia and a panel discussion were held in the sections on Physics and Astronomy, Medical Sciences, and Conservation. Under the auspices of the Geology section a special public lecture on "A Geologist in Tasmania" was given by Dr. Kenneth E. Caster in the late afternoon. Throughout the day on Friday the Junior Division sponsored the Ninth Annual State Science Day in which 620 public school pupils participated. These had been selected from 3556 students who took part in the seven District Science Day meetings held earlier throughout the state. Sectional meetings were suspended at 11 A.M. to give all members of the Senior Division an opportunity to view the projects and exhibits of the junior members. Commercial exhibits were presented by six companies. A tea was held Friday after-

noon for visiting ladies. Wives of science faculty members of Bowling Green State University and of academy officers served as hostesses.

The annual banquet and business meeting were held in West Dining Hall of Founder's Quadrangle Friday evening. Dr. John R. Coash served as toastmaster. Greetings from Bowling Green State University were given by Provost Kenneth H. McFall and the response was made by Dr. Rush Elliott, Dean of Ohio University College of Liberal Arts and Sciences. Dr. Robert M. Geist, president of The Ohio Academy of Science, delivered his presidential address entitled, "Human Engineering." Professor Robert E. McKay, as Executive Secretary of the Junior Division, announced awards to outstanding high school teachers and science departments. At the business meeting officers were elected to serve for the coming year. Appointments were also announced. These new officers and committee members are listed at the head of this annual report. Thirty-nine members of the Academy were announced as newly elected Fellows. Their names and section letters are as follows:

D—M. Alpert	J—C. L. Hahn	J—K. N. Morse
J—J. M. Anderson	G—W. H. Hall	C—C. F. Moses
D—C. G. Barber	B—L. C. Hunsicker	D—E. Ogden
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A—C. C. Davis	C—K. E. Limper	D—W. M. Silbernagel
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C—C. E. Graham	C—W. M. Merrill	H—W. R. Zeitler

Dr. Walter C. Kraatz presented the resolutions prepared by the Resolutions Committee.

On Saturday the section of Physics and Astronomy held a joint meeting with the Ohio Section of the American Physical Society. The section of Geology held an all-day field trip. Two other field trips were sponsored jointly by the sections of Zoology, Plant Sciences, and Conservation.

Respectfully submitted,

Ralph W. Dexter, *Secretary*

REPORT OF THE EXECUTIVE COMMITTEE AND THE COUNCIL

The Executive Committee met on November 30, 1956, and on April 18, 1957; the Council met on December 1, 1956, and on April 18, 1957. The fall meetings were held at The Ohio State University in Columbus and the spring meetings were held at Bowling Green State University. Following is a brief summary of the more important actions taken.

1. *Meeting of the Executive Committee.*—A gift of $25.00 from Dr. C. M. Goethe was assigned to the work of the Junior Division. The Academy was authorized to contribute $12.00 to the Academy conference for 1955 and again for 1956. The Trustees of Research Funds were given instructions to use their own judgement in awarding funds to either college instructors and graduate students or to high school students. A former directive from the A. A. A. S. restricting A. A. A. S. grants to high school students was rescinded. A budget of $75.00 was approved for the use of the Director of Public Relations. An expense account up to $150.00 was made available to the Executive Secretary of the Junior Division. The Treasurer was authorized to purchase one-half share of stock in Banc-Ohio. G. G. Acker was appointed as Executive Secretary of the Junior Division and R. E. McKay was appointed as Assistant Executive Secretary of the Junior Division. Donald Pearce was appointed to fulfill the unexpired term of Morton Coburn as Academy Librarian. Dr. John L. Crites was appointed to replace Sylvan Michaelson as a District Representative in the Junior Division since Dr. Michaelson would be out of the country for two years. Dr. Glenn Blaydes was appointed to replace Dr. Richard Goldthwait as Chairman of the Trustees of Research Funds since Dr. Goldthwait was leaving the country. It was agreed to hold three meetings a year rather than two. A meeting in the early fall would be scheduled for 1957.

President Geist appointed the retiring secretary, Dr. Ralph W. Dexter, to be a committee of one to act as Academy Historian. The President also appointed a new temporary committee on Institution and Corporation Members consisting of Dr. Paul Rothemund, Chairman, Dr. George H. Crowl, and the treasurer Dr. Elton F. Paddock. The former temporary committees on Ohio Flora and Training and Certification of Science Teachers were reappointed with present personnel, but with the addition of Dr. T. R. Fisher to the former committee.

Dr. W. C. Kraatz was selected to be the Local Chairman for the annual meeting to be held at The University of Akron in April, 1958. Dr. George W. Burns was appointed as an alternate A. A. A. S. representative. It was announced that Dr. Thomas H. Langlois had been selected as the new Book Review Editor for *The Ohio Journal of Science*. A suggestion from Dr. F. H.

Krecker that the Academy provide councilors to advise high school students interested in a career in science was acted upon. A call for questions and requests for interviews will be published in the *Newsletter*. Replies will be handled by the Executive Secretary of the Junior Division who will make efforts to provide some qualified scientist living near the students concerned to answer questions and guide them toward proper training for a career in science.

2. *Meeting of the Council.*—Announcement was made of the grant of $12,000 over a period of three years to the Academy for the work of Dr. E. Lucy Braun on the "Woody Plants of Ohio" which will be the first unit in the *Ohio Flora* project planned by the Committee on Ohio Flora, of which Dr. Braun is the chairman. A gift of $1,000 to the Academy by Dr. Charles F. Kettering was also announced.

A discussion was held on the matter of scheduling the meetings of the Junior and Senior Divisions. Some members expressed a desire to hold these meetings on separate days rather than simultaneously as in the past. After much discussion it was agreed to suspend the sectional meetings at 11 A.M. to make available a large number of judges and to permit all senior members an opportunity to view the exhibits of the Junior Division. This would be tried as an experiment at the Bowling Green meeting and each section at its business meeting would vote as to its preference for the future. A report would be sent to the Executive Committee for further consideration.

A discussion was also held concerning the matter of requiring abstracts for all titles submitted for the program, how the abstracts should be distributed, and what arrangements could be made for their publication. The matter was placed on the agenda for sectional meetings to discuss and vote as to preference and to report such action to the Executive Committee for further consideration.

Reports were presented by all officers and committee chairmen. Their annual reports are presented in the following pages. Membership in the Senior Division as of April 18, 1957, was 1172, divided among the sections as follows: Zoology, 265; Plant Sciences, 187; Geology, 184; Medical Sciences, 109; Physics and Astronomy, 63; Geography, 40; Chemistry, 111; Science Education, 95; Anthropology and Sociology, 28; and Conservation, 90. The next annual meeting was scheduled for The University of Akron on April 10–12, 1958.

Respectfully submitted,

RALPH W. DEXTER, *Secretary*

REPORT OF THE TREASURER

FISCAL YEAR 1956

ACADEMY BUSINESS

	1956	*1955*
RECEIPTS:		
Bank Balance, January 1	$ 4,803.54	$3,853.96
Membership Dues	4,145.50	4,175.50
Sale of Publications	6.06	42.34
U. S. Bonds Cashed	150.00	—
Interest U. S. Bonds	47.50	47.50
National Science Foundation Grant	4,800.00	—
Exhibitor Fees (commercial)	—	50.00
Gift—C. F. Kettering	1,000.00	750.00
Gift—C. M. Goethe	50.00	—
Junior Academy	801.15	746.30
	$15,803.75	$9,665.60
EXPENDITURES:		
Subscriptions and Engraving, Ohio Journal of Science	$ 2,089.62	$3,047.06
Printing Annual Report	261.70	118.18
Printing Announcements and Notices	434.38	326.30
Postage, office supplies, bank charges, auditing and other administrative expense	596.50	624.67
National Science Foundation Grant	704.87	—
Junior Academy	958.91	734.11
Academy Conference	—	11.74
Banc-Ohio Stock, ½ share	22.00	—
Bank Balance, December 31	10,735.77	4,803.54
	$15,803.75	$9,665.60
Excess Income over Expense	$ 5,932.23	$ 917.08

RESEARCH FUND

RECEIPTS:		
Bank Balance, January 1	$ 121.44	$ 233.85
Interest, Savings Account	73.64	53.34
U. S. Bond Cashed	100.00	—
Interest, U. S. Bonds	7.50	7.50
Dividends, Banc Ohio Stock	41.25	41.25
Grant, A.A.A.S.	255.00	369.50
	$ 598.83	$ 705.44
EXPENDITURES:		
Grants	—	$ 547.00
Water Mites, Robert M. Crowell	55.00	—
Cincinnati Bats, Elizabeth Smith	50.00	—
Bank Service Charges	5.75	2.65
Interest still in Savings Account	39.29	34.35
Bank Balance, December 31	448.79	121.44
	$ 598.83	$ 705.44
Excess Income over Expense 1956	$ 327.35	—
Excess Expense over Income 1955	—	$ 97.05

Respectfully submitted,

ELTON F. PADDOCK, *Treasurer*

REPORT OF THE ACADEMY LIBRARIAN

The Librarian is pleased to inform the Academy that its official *Journal*, as of 15 April 1957, is being used to secure exchange publications from 527 institutions. Of these 394 are foreign and 133 domestic. This represents a net increase of 29 over last year; actually 32 were added and 3 exchanges were dropped—one for lack of reciprocation, one because of change of issuing authority, and one because the issuing agency went out of existence. A large percentage of these additions were behind the Iron Curtain where we have had much freer contact than previously.

An additional 23 institutions are at present being contacted and we hope for successful exchange arrangements with them.

No sales of Academy publications were made through the Librarian during the past year.

Respectfully submitted,

DONALD J. PEARCE, *Librarian*

REPORT OF THE JOINT ADMINISTRATIVE BOARD OF THE OHIO JOURNAL OF SCIENCE

The annual meeting of the Joint Administrative Board of The Ohio Journal of Science was held at Columbus on April 13, 1957. The meeting was called to order by Board Chairman Spieker. Present were Mr. E. M. Spieker and Mr. B. S. Meyer, representing The Ohio State University, Mr. C. E. Hoel and Mr. A. W. Lindsey, representing The Ohio Academy of Science, and Mr. H. L. Plaine and Mr. R. A. Popham, of The Ohio Journal of Science staff.

Mr. Meyer was elected chairman of the board for the year 1957–58.

Mr. Spieker notified the board that, having served as a member and chairman of the board for ten years or more, he intended to ask President Fawcett to select someone to replace him on the board. It is Mr. Spieker's opinion that the O.S.U. members of the board should serve short, staggered terms much as the O.A.S. members do.

The report of the Business Manager was approved as read. This report, which accompanies these minutes, is mainly in the form of a financial statement for Volume 56. Mr. Popham reported that, with the money appropriated in the O.A.S. budget, the Journal should be able to meet all expenses and retain about the same amount of reserve funds that it had at the end of 1956.

The report of the Editor, Mr. Plaine, was approved as read. A copy of this report is attached to these minutes. The editor indicated that the Journal is only 3 to 5 months behind in the publication of papers and book reviews. It was pointed out that this is an unusually favorable state of affairs when the much longer lag periods of other scientific journals is considered.

Upon hearing Mr. Plaine's request for a ruling, the board reaffirmed its policy of excluding technological papers from the Journal.

The board accepted, with regret and with sincere thanks for a job well-done, the resignation of Mr. Fisk, who has served as Book Review Editor since July 1952.

The following staff members were elected for the year 1957–58: Mr. Plaine, Editor; Mr. Popham, Business Manager; and Mr. T. H. Langlois, Book Review Editor.

Mr. Lindsey expressed the appreciation of the Academy for the efficient work of the Journal staff members during the past year.

Respectfully submitted,

RICHARD A. POPHAM, *Secretary of the Board*

THE OHIO JOURNAL OF SCIENCE

VOLUME 56—FISCAL YEAR 1956

BALANCE SHEET

RECEIPTS:	
Bank balance at beginning of period	$2,715.11
O.S.U.—paid for subscriptions	2,500.00
O.A.S.—paid for subscriptions	1,942.00
Non-members—paid for subscriptions	670.00
Separate numbers, volumes and reprints sold	385.38
50 year index sold	54.00
O.A.S.—paid ½ cost of plates	258.46
O.A.S.—paid for annual report	147.62
Miscellaneous	295.98
Advertisements	478.96
	$9,447.51
EXPENDITURES:	
Spahr and Glenn—printing O.J.S.	$5,475.96
Bucher Engraving—plates	519.08
Postage and express	170.15
Secretary and labor	100.50
Office expenses and bank charges	163.54
Advertising of the O.J.S.	1.10
Reprints	3.20
Refunds	.50
Miscellaneous	262.16
Bank balance at end of period	2,751.32
	$9,447.51
Cost of supplying one volume of six numbers	$3.163

THE OHIO JOURNAL OF SCIENCE

REPORT OF THE EDITOR OF VOLUME 56, 1956,
to the Joint Administrative Board

Volume 56 of The Ohio Journal of Science contained 408 pages, of which 354 pages were devoted to 46 scientific papers in 8 fields of science (as designated by sections of The Ohio Academy of Science); 14 pages were devoted to affairs of the Academy; 12 pages to advertising; and 28 pages to announcements, book notices, index, and routine journal copy.

Dr. Frank Fisk, *Book Review Editor*, reported 43 book notices or reviews published in volume 56 and 59 books presented to The Ohio State University Libraries in December.

Respectfully submitted,

HENRY L. PLAINE, *Editor-in-Chief*

REPORT OF THE DIRECTOR OF PUBLIC RELATIONS

Apprising the general public of the activities of the Academy, aside from the annual meeting and the Junior Division competition, has, until this year, not been given serious attention. Tradition has determined that the work of our scientists speak for itself, primarily in scientific circles. This tradition of modesty, together with inaccuracies born of faulty reporting in the press and the requirements of condensation in newspapers, has made scientists reluctant to favor any strong program of "publicity."

As our social climate has changed, however, two conditions have interposed themselves between tradition and the earnest and honest motives of the modest scientist. One is the

need for attracting more and better science students to careers in science, a problem necessitating long-range "publicity," and the other is the false but quite evident belief among the non-scientific citizenry that whatever is not given substantial publicity may be valueless. These attitudes can be ignored at the risk of having other agencies which are responsible for planning the society's future undertake the enlightenment of the public, or can be understood by scientists to the extent of satisfying the expectations of the public by giving credit publicly to scientists and their contribution to the society.

Since December I have issued six sets of news releases containing from four to six items each. These have been mailed to approximately one hundred and thirty Ohio newspapers in a form ready to set to type. On the supposition that most newspapers prefer brief accounts of general interest to lengthy scientific articles, all the items were less than two hundred words. Information for the releases was obtained from several sources. The Secretary sent news about members and about the Academy's activities in general. The Junior Division *Newsletter* was combed for topics. Twenty members giving papers at the annual meeting were asked to submit abstracts of their work; they were selected from advance copies of the Program on the basis of my judgment of the newsworthiness of their titles.

A file of clippings has been begun, contributed mainly by members of the Council at my request from their own local papers and news bureaus. That some of our material is acceptable to the newspapers is evident from the growing file. It is equally evident, however, that we must consult experts, such as science editors of the large dailies, to make our modest funds go farther. There is almost no way to justify expenses without subscribing to expensive clipping services. But in spite of the reservations I have about the success of this small beginning, I am confident that an important step has been taken toward a desirable and dignified presentation of Academy activities to the public.

There is no way we can estimate two accomplishments that are bound to result from a constant stream of news items: first, young individuals who are making decisions for their life's work may by chance decide to become scientists upon reading a news item; if this should occur only a few times in the course of a year, it could be said that the effort and energy and funds expended have been justified. But a greater second accomplishment is the likelihood that the general public, through this means, will increase its attention to science education; and the critical position the public occupies as the controlling influence in improving schools and hiring teachers will be correctly oriented in communities where so much of the future of science is even now taking shape at the "grassroots" level and a more vital service can thus be performed by our Office of Public Relations.

Respectfully submitted,

LINCOLN C. PETTIT, *Director of Public Relations*

REPORT OF THE EXECUTIVE SECRETARY OF THE JUNIOR DIVISION, OHIO ACADEMY OF SCIENCE

This report closes the ninth year of the activities of the Junior Division of The Ohio Academy of Science, and perhaps the most successful year thus far, at least from the standpoint of the number of public school students enrolled. A total of 3556 junior and senior high school students participated in the seven District Science Days over the State.

March 23	—Miami University	484
	Muskingum College	125
March 30	—Ohio State University	801
April 6	—Ohio University	184
	—Kent State University	456
	—Bowling Green State University	1149
	—Wittenberg College	357

From a total enrollment of only 78 at the First State Science Day at Denison University in 1949, the number has increased to about 620 this year.

It has certainly been gratifying to see the increasing interest which the Senior Academy has shown for this program. Various industries throughout the state have begun to show interest in our program. High School Teachers have certainly been enthusiastic for the program.

This year, three issues of the *Newsletter* have been published thus far, with a fourth to be put out directly after the State Science Day. The *Newsletter* has been sent to all science teachers over the state, in so far as the list could be determined. All issues have been sent to the Academy members, while the first issue was sent to all public school superintendents.

The Academy has granted seven "Outstanding Teacher Awards" during the year, one in each district. The Kroger Co. has very graciously presented an award with a stipend to seven high schools during the year for outstanding participation of their students in science and in our program. This will be the second year that the Owens-Illinois Glass Co. has presented a

set of glasses to all entrants in the State Science Day. Three more industrial firms have expressed an interest to participate in some way.

In February, the Executive Secretary of the Junior Division attended a national conference in Chicago where representatives of the various state Junior Academies assembled to discuss our common problems. Only one state has a larger number of junior members enrolled, and it seemed evident that our program ranked among the top in the country. It seems evident at this time that by fall there will be a new district formed at Heidelberg College. In order to have a better equality in district sizes, more districts will doubtless be formed in the future.

Because of certain involvements, I find it necessary to step down from the job of Executive Secretary of the Junior Division. Mr. Gerald Acker has been appointed my successor by the Executive Committee of the Senior Academy and I am sure that Mr. Acker will do an excellent job. I shall serve as his assistant.

Respectfully submitted,

ROBERT E. MCKAY

REPORT OF THE OHIO FLORA COMMITTEE

This report is divided into two sections:

1. Work on "Woody Plants of Ohio"—that part of the "Vascular Flora of Ohio" currently supported by a National Science Foundation grant.

This will be a book, the contents as outlined here:

Introduction:
- Scope of work; nomenclature; herbarium records and permanent file; physical features of Ohio with maps (physiographic divisions, glaciation, lithology, etc.); natural vegetation.

Systematic Section:
- Keys to genera
- Systematic text—information about families, genera, and species, with keys to species.
- Illustrations of a large proportion of the species (leaves, flowers and fruits—of some species, winter twigs)
- Maps showing Ohio distribution of all native species.

Glossary

Index

The systematic section, of some 350 to 375 typed pages, is now in essentially complete form (except for the keys to genera) and is being revised where further study of specimens makes this necessary. The complete manuscript of the genus *Crataegus* (37 pp.) has been received from E. J. Palmer, the specialist in this genus, and is incorporated in the typed text.

A large number of beautiful illustrations have been drawn by the artist employed with National Science Foundation funds.

Preliminary Ohio distribution maps have been made for all native species.

A great many additional records have been added during the past year from specimens deposited in the O.S.U. Herbarium, many of which were collected by Dr. E. M. Herrick.

About 70 percent of the O.S.U. herbarium specimens of woody plants have been checked, i.e., about 8000 sheets, and those on which county records are based are marked on specimen and on corresponding herbarium slip.

Another year's work should see "Woody Plants of Ohio" well along toward completion. Completion of work on woody plants will mean that work on about ⅙ of Ohio's species (and probably ⅓ of the specimens) will be in such form that it can readily be modified and incorporated in the complete Flora.

2. Work on other parts of the "Vascular Flora of Ohio."

The annual meeting of the Flora Committee was held in Columbus on March 16, 1957, at which time the flora project as a whole was discussed, as well as the problems arising in connection with woody plants.

In as far as possible, progress will be in systematic order, which means that the monocots as a whole will be started as soon as work on woody plants has reached a stage permitting this.

Dr. Clara Weishaupt is continuing work on the grasses, which group contains a considerable fraction of all monocots.

The study of legumes by Dr. Gambill of Ohio University is continuing.

Significant progress has been made with the Compositae; Dr. Long of Ohio Wesleyan University hopes to have a preliminary list prepared by this summer.

The committee will continue to encourage work on any group, by any qualified worker, with the understanding that the committee reserves the privilege of rearranging or rewriting, if necessary, for unity of treatment.

Respectfully submitted,

E. LUCY BRAUN, *Chairman*

REPORT OF THE COMMITTEE ON TRAINING AND CERTIFICATION OF SCIENCE TEACHERS

During the course of the first year's work the committee was divided into sub-committees as follows:

Sub-committee No. 1—Pettit and Linscheid
Sub-committee No. 2—Crowl, Van Cleef, and Beaver
Sub-committee No. 3—Linscheid, Fullerton, Porter, and Baird
Sub-committee No. 4—Strahler, Coash, Corwin, Wilson, Van Cleef
Sub-committee No. 5—McGrath, Longbrake, Beaver, Coash, Buckingham, and Herrick

To the original list appointed last April have been added the names of Dr. J. H. Buckingham, Dr. John Coash, Dr. Charles Riley, Dr. George Baird, and Dr. J. Arthur Herrick. The first named committee member on each sub-committee was chairman of the group.

Much work by the committee was done through correspondence. In addition to the correspondence work the committee had two meetings during the year; one on the afternoon of Saturday, December 1, 1956; the other on Saturday forenoon and afternoon, February 16, 1957. Both meetings were held at The Ohio State University, Columbus, Ohio, and both were well attended. The willingness of the majority of the committee members to travel long distances to these two meetings and to invest considerable time and money on this undertaking indicates that its members are interested in our problem and willing to work at it.

One problem was to write down some of the fundamental considerations or criteria that might very well be used as guides in our further work. Pettit and Linscheid were given this task because these two men both attended in 1955 the North Central Conference on Biology Teaching held at Cheboygan, Michigan.

Another problem was to make some study of the mechanics of certification and in so doing to make personal contact with the appropriate person or persons in the State Department of Education. It seemed wise also to try to let the certification authorities know that we, as representatives of The Ohio Academy of Science, are very much interested in certification and that while we are in no way desirous of dictating certification requirements, we are intensely interested and will be glad to help in any way that we can be of assistance. Crowl, Van Cleef, and Beaver carried through this undertaking in a fine way. The Academy must see that the fine relationships started by this sub-committee are continued and further strengthened. This sub-committee obtained and reported some very pertinent information.

A third problem, a study of the pre-service and in-service training of elementary teachers in science, proved to be one of the most promising fields for investigation. This committee, made up of Linscheid, Fullerton, Porter, Riley, and Baird, has worked hard. The members conveniently located held one extra all-day meeting at Kent State University. Two major enterprises are under way. The first is an inquiry into the present conditions of elementary science teaching. The report of this sub-committee states, "As a first step in this inquiry a status study of science teaching in the Shaker Heights elementary schools has been undertaken. This study, under the direction of Dr. George Baird, may serve as a pattern for a survey in other areas." The second is a survey of the Ohio Colleges and Universities to learn what science is required in these schools for graduation of prospective elementary teachers. A pilot study in this area, under the direction of Dr. Charles V. Riley, has already been completed.

The fourth problem was a study of the undergraduate training of high school teachers in science and the kind of certification that seems best for them. New standards for the certification of science teachers in secondary schools in Ohio went into effect January 1, 1956. These new standards are now supposed to be among the highest of any state in the Union. The report of the subcommittee, written by Dr. John Coash, raises questions regarding the relative merits of the comprehensive major in science in contrast to the more specific majors in special science subjects. Concern is also expressed about the omission of certain science subjects, notably geology, from the comprehensive science major.

A fifth problem was a study of the fifth year of training in science for classroom teachers, both elementary and high school. The report of the sub-committee submitted by Dr. James McGrath indicates that the committee reached general agreement on four points under consideration, mild agreement on one and marked disagreement on another. The question that brought about the furor is as follows: Can courses with few or no pre-requisites be given in special science departments in colleges and universities, to teachers who already have the bachelor's degree, for graduate credit. As the report of the sub-committee says, "This cleavage is probably present among all college science professors and is, perhaps, not responsive to compromise."

The committee is unanimously of the opinion that this good work should be continued. It recommends that the present committee be continued or another one be appointed to carry on the work. Some undertakings are well under way but not yet completed.

Respectively submitted,

HARRY A. CUNNINGHAM, *Chairman*

REPORT OF THE RESOLUTIONS COMMITTEE

Be it resolved that the members of The Ohio Academy of Science express to the Administration of Bowling Green State University, to Dr. J. R. Coash, chairman of the local committee on arrangements, and to the several members of his committee, their appreciation of the excellent facilities and thoughtful hospitality which have contributed greatly to the success of this, the 66th annual meeting of the Academy. Be it further resolved, that the members of The Ohio Academy of Science express to Dr. Ralph W. Dexter their appreciation of his work as Secretary, a position from which he is retiring after three years of tireless and efficient service.

Respectfully submitted,

RALPH V. BANGHAM
WILLIAM H. SHIDELER
WALTER C. KRAATZ, *Chairman*

REPORT OF THE NECROLOGY COMMITTEE
for the Period of April, 1956 to April, 1957

During this interval six members have died. The necrology report for 1955 recorded seven deaths while that for 1956 reported ten. The obituaries accompanying this report include three for men who died in 1955 but whose deaths did not come to the attention of the Necrology Committee until after the April, 1956 meeting. Concerning one deceased member, John W. Magley of Cincinnati, who died in 1955, the chairman received no reply to his letter requesting biographical material; and one member, John P. Baker, died in an automobile accident in Columbus, Ohio, late in March 1956. No reply furnishing biographical data has been received up to April 18, 1956.

From the accompanying ten obituaries, we deduce the following items of interest: two were octogenerians; two in their seventies; two in the sixties; and two in the fifty-year group. The average age was sixty-six. As to cause of death, heart failure claimed at least three; uremia one, and another died of pneumonia while suffering from cancer. There were three deaths of which your committee was unable to learn the exact cause.

Respectfully submitted,

JOSEPH T. MADDOX, *Chairman*
H. H. M. BOWMAN
PAUL ROTHEMUND

HAROLD JOHN KERSTEN

Professor of Biophysics and Fellow of the Graduate School of Arts and Sciences at the University of Cincinnati. Fellow of the Zoology Section of The Ohio Academy of Science.

Dr. Kersten was born in Carroll County, Illinois. He received his Bachelor and Master of Science degrees in electrical engineering from the University of Wisconsin in 1923 and 1924; Master of Arts degree in mathematics from the University of Chicago in 1926, and Doctor of Philosophy in physics from the University of Cincinnati in 1937. He taught at the University of Cincinnati from 1926 until the day of his untimely death, March 3, 1955. Dr. Kersten leaves a widow, Dorothy Meader Martin Kersten.

As a biological physicist, Dr. Kersten had conducted many significant research projects. He published more than 80 papers in American scientific journals and held several patents, two of which were assigned to the University of Cincinnati and one to the University of Cincinnati Research Foundation, of which he was a trustee. He also served as a consultant for several industries.

Dr. Kersten was a Fellow of the American Physical Society, American Association for the Advancement of Science, and The Ohio Academy of Science. He held membership in the American Chemical Society, American Mathematical Society, American Society of Plant Physiologists, Engineering Society of Cincinnati, and American Association of University Professors.

He was buried March 5, 1955, in Spring Grove Cemetery, Cincinnati, Ohio.

AMOS HENRY HERSH

Biologist, Professor of Biology at Western Reserve University since 1946 and a member of the faculty since 1923.

Dr. Hersh was born in Quarryville, Pennsylvania, on November 2, 1891. He received his Bachelor of Arts degree in 1914, his master's degree in 1915 from Franklin and Marshall College, and his Doctor of Philosophy from the University of Illinois in 1922. In 1915 he went to Princeton as an assistant in the biology department. From there he went to Kansas State College as Instructor in Biology from 1916 to 1918. He was an instructor at Marquette Uni-

versity for the academic year 1918–1919. From there he became a fellow in zoology at the University of Illinois 1919–1922. He served as an instructor in zoology at the University of Michigan 1922–23, from which post he left to become Instructor in Biology at Western Reserve where he was named Assistant Professor in Biology in 1925, advanced to Associate Professor in 1936 and appointed Professor in 1946, which position he filled until his death August 28, 1955.

His alma mater awarded him an honorary Doctor of Science degree in 1946.

Dr. Hersh has done a large amount of research in the field of heredity and genetics and has written numerous articles for professional journals in these fields.

He was a member of the American Society of Zoologists, Genetics Society of America, the American Naturalists, Sigma Xi, the American Association for the Advancement of Science, and The Ohio Academy of Science.

On August 19, 1922, he married Roselle Karrer of Seattle, Washington, in Urbana, Illinois. Mrs. Hersh is Assistant Professor of Mathematics at Western Reserve. They have two sons, Charles Karrer, who is with the Armour Research Foundation and teaches chemical engineering at Illinois Institute of Technology; and Robert Tweed who is a biophysicist with the DuPont Company at Wilmington, Delaware.

John Lyon Rich

Professor and Head of the Department of Geology at the University of Cincinnati, from which he had retired at the end of the 1954–1955 academic year. Fellow of the Geology section of The Ohio Academy of Science.

Dr. Rich died of a heart attack at Logan, Ohio, on May 21, 1956, while on a trip for the Ohio Natural Resources Commission of which he was a member. He had suffered a previous attack in December, 1953.

He was born in Hobart, New York, December 1, 1884, and after graduating from Hobart High School attended Cornell University where he obtained his bachelor's degree in 1906, his master's in 1907, and doctor's degree in 1911. He was Instructor in Geology at Cornell from 1909 to 1911; an instructor and associate in geology and geography, University of Illinois, from 1911 to 1918; consulting geologist and oil geologist for various companies from 1919 to 1931; Assistant Professor and Professor of Economic Geology, University of Cincinnati, from 1931 to 1935, when he became Research Professor of Geology.

Dr. Rich was elected an honorary member of the Association of Geology Teachers. He was a member of the Association of Petroleum Geologists, American Institute of Mining and Metallurgical Engineers, the Association of American Geographers, American Geophysical Union, Geological Society of America, and The Ohio Academy of Science.

Dr. Rich was noted chiefly for developing a new technique for making geological surveys from airplanes. He served on secret missions for the government of the United States and China during World War II to speed the Allied war effort by getting petroleum fuel. During World War I he was a captain in the military intelligence division of the U. S. Army.

He is survived by his widow, Nellie Barrett Rich; a son Ralph, with the Air Force, a daughter Catherine Louise Getchell, and six grandchildren.

William Pearce Holt

Formerly Head of the Department of Geography and Geology, Bowling Green State University. Fellow in Geography, Ohio Academy of Science.

Mr. Holt was born June 7, 1875, at Geneva, Ohio and died of uremic poisoning June 12, 1955, and interred in Oak Grove Cemetery, Bowling Green, Ohio.

After leaving Geneva High School he entered Oberlin College and received his bachelor's degree in 1898. He did graduate work at the Universities of Chicago, Cornell, Columbia, and Michigan where he received his master's degree.

After teaching in high schools in Toledo, Ohio, and Newark, New Jersey, he went to Bowling Green State University in 1915 where he remained until his retirement in 1942. He also taught some classes in the University of Toledo and did personnel work at the Erie Proving Grounds during World War II.

Mr. Holt wrote *Practical Visualizing, The Geography of Ohio, Ecology of Isle Royale with notes on the vegetation of Isle Royale*, conducted a column in the Toledo Blade under the titles of "Nature is Interesting" or "Strange Animals of the World" and articles on Ohio geology and geography. He contributed articles to the Ohio Archaeologist, and left a nearly completed manuscript called *Indian Artifacts*.

He was a member of the Archeological Society of Ohio, Ohio Indian Relic Collector's Society, Trustee of the Ohio Retired Teacher's Association, Honorary life member and founder of the Toledo Naturalists' Association and a member of The Ohio Academy of Science.

He is survived by his widow, Mabel McLeary Holt, and two daughters, Ruth Holt Wolfe Falls, Wilma Holt Krohm, and two grandchildren.

Frank W. Reed

Dr. Frank W. Reed, Professor Emeritus of Ohio University, died November 22, 1956, at his home in Athens. Death came at the age of 75, following a brief illness.

A graduate of Peabody College, Tennessee, and the University of Virginia, Dr. Reed taught mathematics at Ohio University from 1923 until his retirement in 1951.

It was under his guidance, when he was Associate Professor of Mathematics and also a teacher of astronomy, that the university's first observatory was erected on North Hill. Dr. Reed supervised designing and equiping the building which housed the telescope.

Before coming to Ohio University, Dr. Reed taught at the University of Illinois for 12 years and at Cornell University for four years.

He was a member of Sigma Xi, the Mathematical Association of America, the American Mathematical Society, and a Fellow of the American Association for Advancement of Science and The Ohio Academy of Science.

He is survived by his wife Kate G. Reed; two sons, the Rev. Peyton D. Reed, Milford, and John Waller Reed, Columbus; and three grandchildren.

Charles Clifford Huntington

Professor Emeritus of Geography, Ohio State University, and Fellow of the Geography section, Ohio Academy of Science.

Dr. Huntington, or Cliff as he was affectionately known to his close associates, was born January 12, 1873 on a farm in Clark County near Springfield, Ohio, and died November 29, 1956. He would have been 84 on January 12, 1957.

He received the B.Sc. degree from Antioch College in 1896. Later he attended Ohio State University and received his Ph.B. degree in 1902 and his master's in 1903. He was in residence at Cornell University 1904–1906 and was awarded his doctor's degree in 1915.

He began his teaching career as a youth of 17 or 18 in a country school in Clark County. From 1896 to 1901 he was principal of the high school in Fairfield, Ohio. At Cornell University he was an assistant in the Department of Political Economy and Finance, 1905–1906. During the next three years, 1906–1909, he was a special examiner of the Bureau of Corporations, U. S. Department of Commerce. He returned to teaching when he was appointed Assistant Professor in the Department of Economics and Sociology at Ohio State University. In 1914 he was advanced to the rank of professor. In 1922 he was given the opportunity to develop the Department of Economic and Social Geography and was named as the first chairman. The name was changed to Department of Geography in 1924 and he continued as chairman until 1934 when he gave up his administrative duties. At the end of the academic year 1942–43 he retired and became Professor Emeritus.

He was a member of the American Economic Association; American Association for the Advancement of Science; American Association of University Professors; American Geographical Society; Association of American Geographers; National Council of Geography Teachers; Ohio Archeological and Historical Society; Foreign Policy Association; and The Ohio Academy of Science.

Professor Huntington was married to Stella L. Barkman on June 27, 1906. She died on April 2, 1928. He later married Helen E. Hughes of Cedar Rapids, Iowa, on January 11, 1933. She survives him. He was interred in the family burial ground near Enon, Ohio.

Lawrence Emerson Hicks

First Director of the Ohio Wildlife Research Station, Ohio Division of Conservation, Ohio Department of Natural Resources, and Fellow of the Zoology section, Ohio Academy of Science.

Dr. Hicks was 51 at the time of his death. He graduated from Otterbein College in 1928, and received his master's degree in 1929 and his doctor's degree in 1933 from The Ohio State University. He served as game ecologist with the Ohio Division of Conservation from 1929 to 1931, and as a forester and wildlife conservationist with U. S. Soil Conservation Service from 1934 to 1936. He had been an assistant in the biology department, Otterbein College, 1926 to 1928, and first an assistant and then an instructor at Ohio State from 1928 to 1930. He was Director of the Ohio Wildlife Research Station from 1936–1945.

At the time of his death Dr. Hicks was owner and operator of the Buckeye Apiaries at his Chatham Rd., Columbus, residence. In 1938 he was the United States delegate to the International Ornithological Congress, Rouen, France.

Dr. Hicks was a Fellow and former Secretary of the American Ornithologists' Union, a member and former officer of the Ohio Archeological and Historical Society, a member of Sigma Xi, and a Fellow of The Ohio Academy of Science.

He is survived by his widow, Thyra DeVies Hicks; a daughter, Mrs. Clement A. Hastie; a son Thomas E. D. Hicks at home.

He was buried in the family burial plot at Fredericktown, Ohio, on January 22, 1957.

JOHN H. HOSKINS

Chairman of the Department of Botany and Bacteriology at the University of Cincinnati College of Arts and Sciences; died in his sleep at his home on February 8, 1957; aged 61 years.

A native of Carmel, Indiana, Dr. Hoskins received the Bachelor of Science degree from Earlham College in 1919, and master's and doctor's degrees from the University of Chicago in 1920 and 1924.

Dr. Hoskins served with the United States Army 1917–1919, and with the War Department Training Branch, Quartermasters Corps, 1943–1945. He was Associate Editor and Editor for paleobotany of the American Midland Naturalist, and an assistant editor and co-founder of Lloydia, quarterly journal of biological science published by the Lloyd Library, Cincinnati, Ohio. He was a member of the board of Lloyd Library, and of the Cincinnati County Day School. From 1946 to 1953 he served as regional representative of Earlham College.

Dr. Hoskins was a member of Phi Beta Kappa and Sigma Xi; International Society of Plant Morphologists; Phytological Society; the Academies of Science of Ohio, Illinois, and Indiana, and President of the Botanical Society of America.

His widow, Gertrude Keller Hoskins, and three sons, John H. Jr., William K., and Robert L. survive.

Dr. Hoskins served on the Committee on Local Arrangements when the Academy met at the University of Cincinnati in 1928 and was Membership Secretary, 1930, and Executive Vice President of the Plant Science Section The Ohio Academy of Science in 1931.

Introduction to Bacterial Physiology. *C. E. Clifton.* McGraw-Hill Book Company, Inc., New York. 1957. 414 pp. $8.50.

This is a new book which emphasizes chemical aspects of bacterial physiology. Although most of the text is pitched at a relatively elementary level, previous comprehensive training in organic chemistry is required for understanding the book and beginning courses in physical chemistry and calculus are desirable prerequisites.

The book covers general principles of physical and colloidal chemistry; cytology of bacteria; microbial metabolism; autotrophic and heterotrophic bacteria; and growth, variation and death of bacteria. The style and content are conservative and conform fairly well to previous texts on bacterial physiology. Tables, graphs, and illustrative diagrams are used frequently to clarify various principles. The publishers present an attractive, well-bound, and easily read text.

Bibliographies of recent and pertinent literature are included at the end of each chapter. "Introduction to Bacterial Physiology" is a good text and should prove to be of special value for reference use.

GRANT L. STAHLY

Structural Geology. *L. U de Sitter.* McGraw-Hill Book Company, Inc., New York. 1956. vi+552 pp. $11.00.

This book, written by a distinguished Dutch geologist, is intended for a trained geologist or an advanced student; it is not suitable as a text in an introductory course in structural geology. The book has special interest for American geologists because it contains an up-to-date account of the structure of numerous tectonic areas of Europe. It is primarily concerned with systematizing detailed knowledge about structural geology in order to distinguish genetic relationships.

Part One, Theoretical Structural Geology, describes physical properties of rocks, experimental work, and rock behavior in tectonic processes. In Part Two is much detail on comparative structural geology, proceeding from simple to more complex structures. Part Three defines some characteristics of the largest structural units and discusses theories concerning their origin. The author accepts the notion that intensity of folding and faulting vary somewhat erratically in time and place over a stressed region. He distinguishes only three world-wide orogenic periods, and recognizes that even these are not fully equivalent.

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